

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

- 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 & Anaplasia

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

Differentiation & 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.

Differentiation & Anaplasia

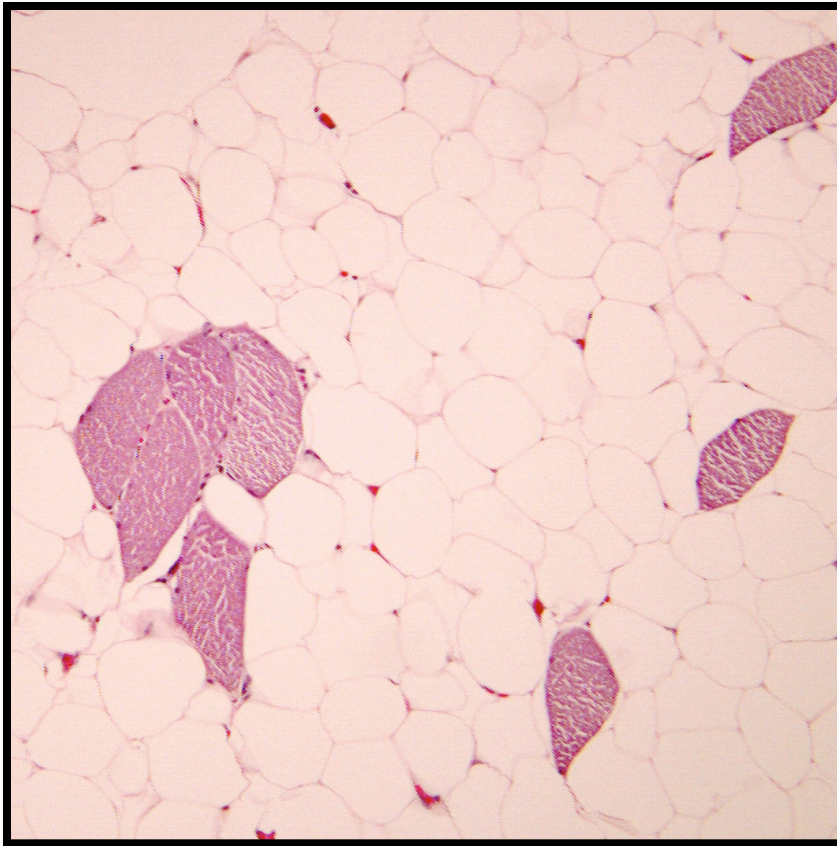
- The more differentiated the tumor cell, the more completely it retains the functional capabilities of its normal counterparts.
 - e.g. benign neoplasms and even well-differentiated cancers of endocrine glands frequently elaborate the hormones characteristic of their origin.

Differentiation & Anaplasia

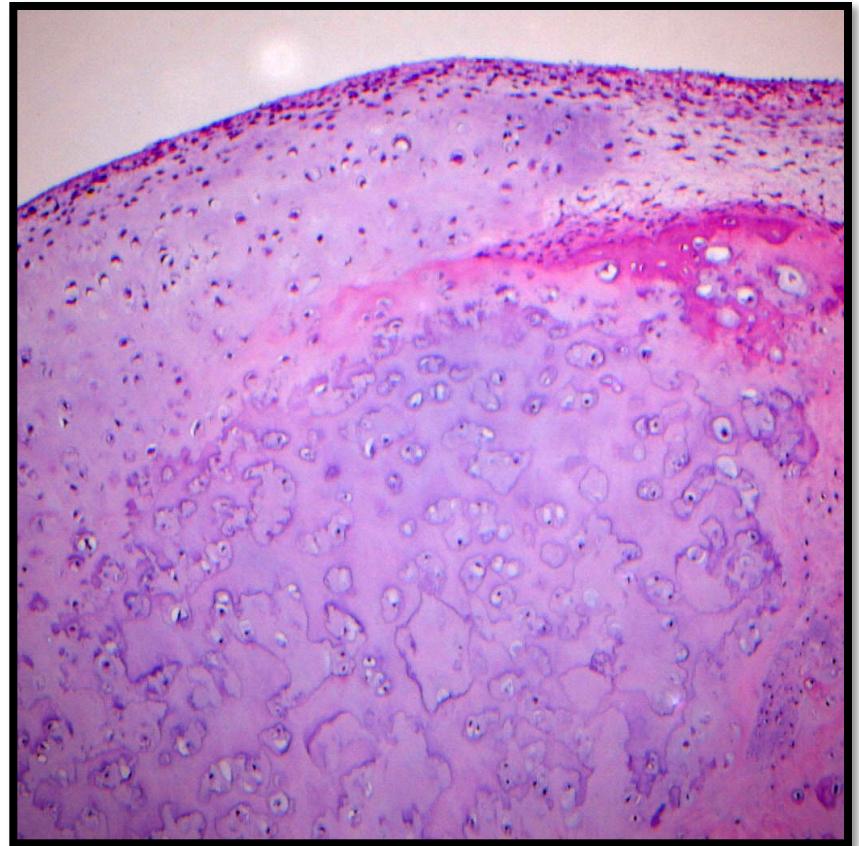
- The stroma carrying the blood supply is crucial to the growth of tumors but does not aid in the separation of benign from malignant ones.
- However the amount of stromal connective tissue determines the consistency of a neoplasm.
 - e.g. certain cancers induce a dense, abundant fibrous stroma (*desmoplasia*),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

Differentiation & Anaplasia

Lipoma



Chondroma

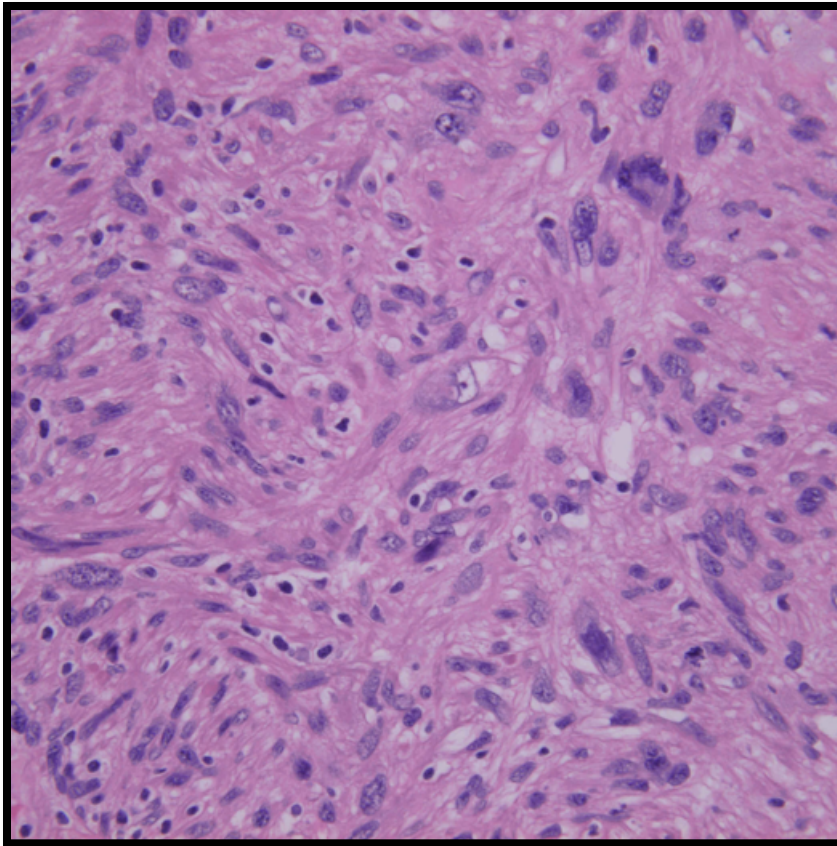


Differentiation & Anaplasia

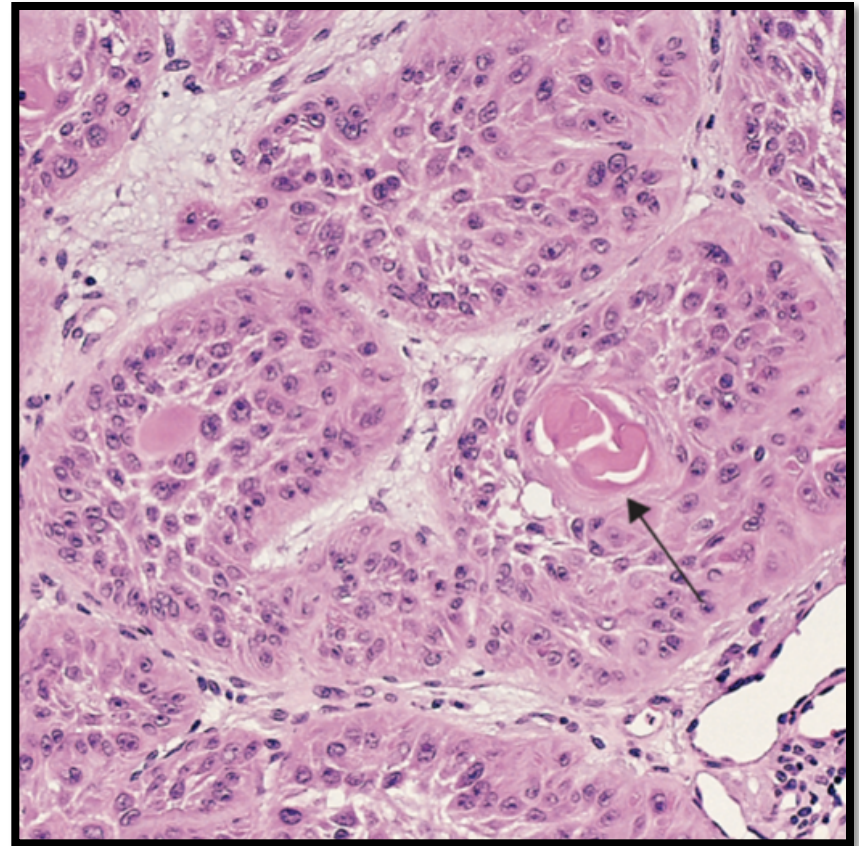
- Malignant neoplasms are characterized by a wide range of parenchymal cell differentiation: from well differentiated to completely undifferentiated.
- Between the two extremes lie tumors loosely referred to as moderately differentiated.

Differentiation & Anaplasia

Leiomyosarcoma



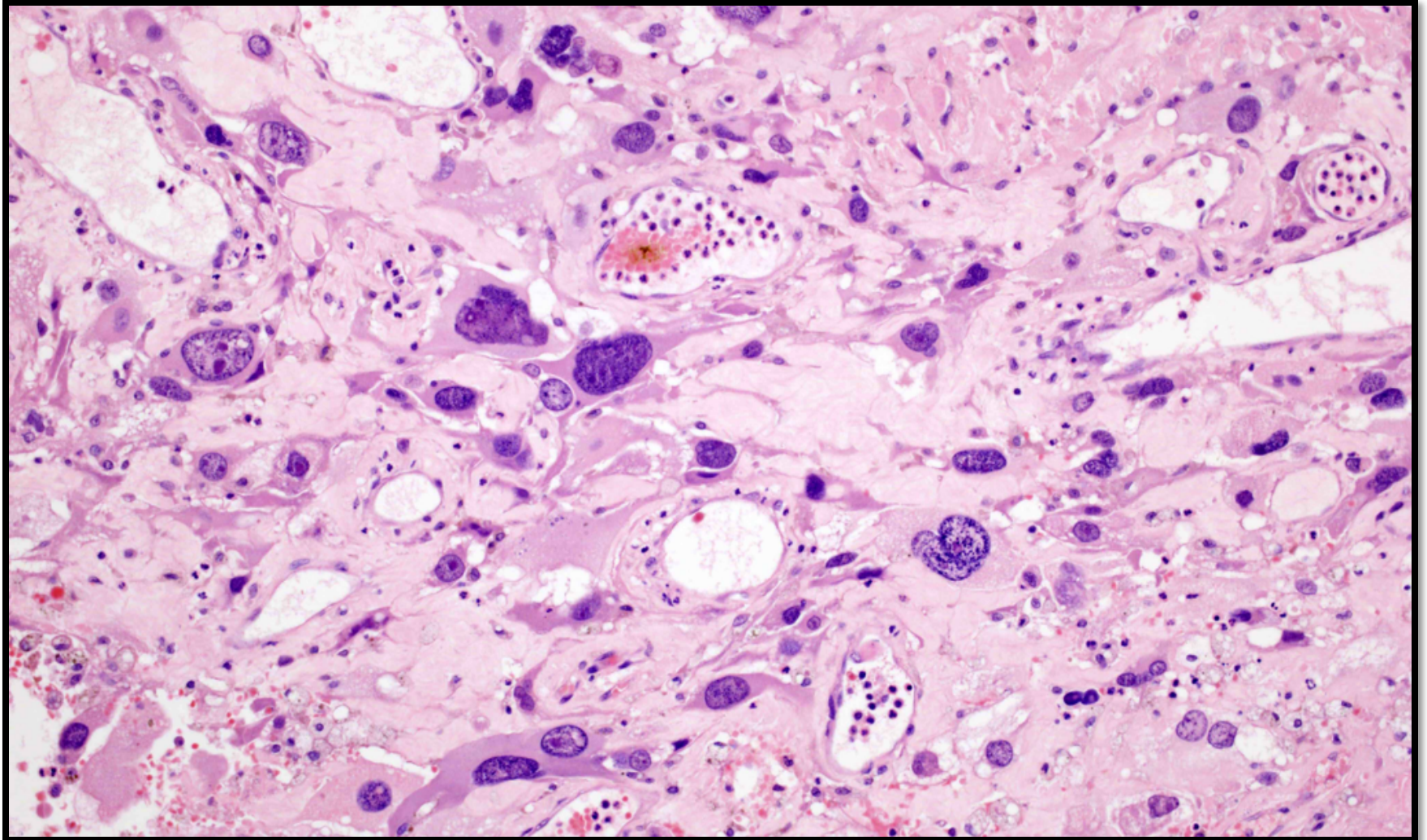
Squamous cell carcinoma



Differentiation & Anaplasia

- 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.

Differentiation & Anaplasia

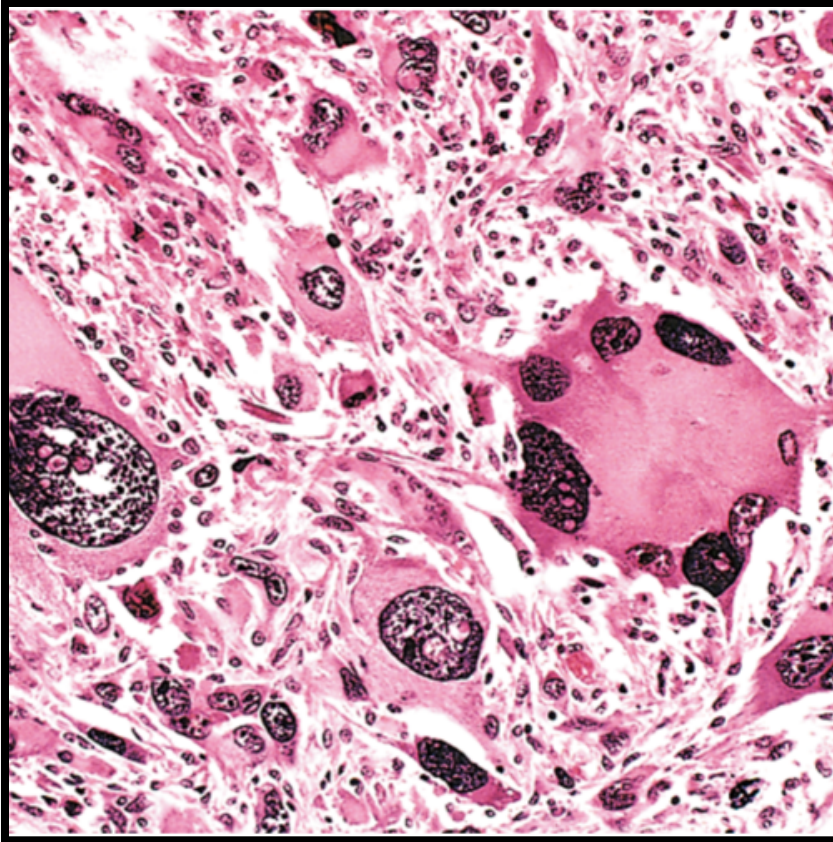


Differentiation & Anaplasia

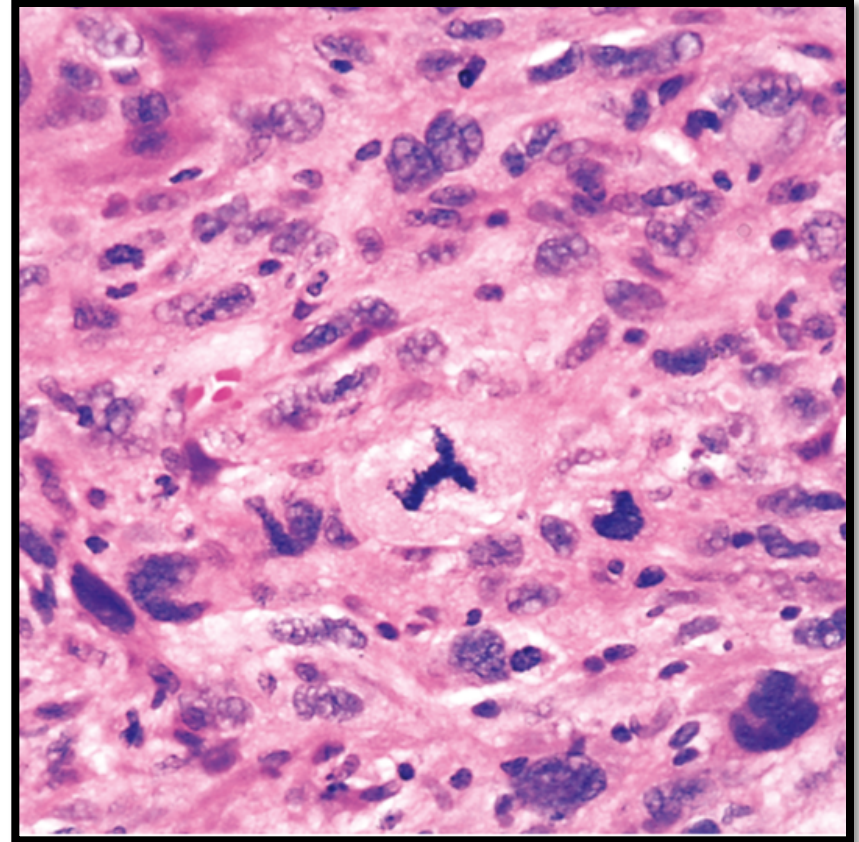
- It is important to recognize the following histopathological features in any neoplasm:
 - Pleomorphism: variation in size and shape
 - Enlarged nuclei resulting in an increase of nuclear to cytoplasm ratio (that may approach 1:1 instead of the normal 1:4 or 1:6)
 - Hyperchromasia (dark nuclei) due 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.

Differentiation & Anaplasia

Tumor Giant Cells



Atypical Mitosis



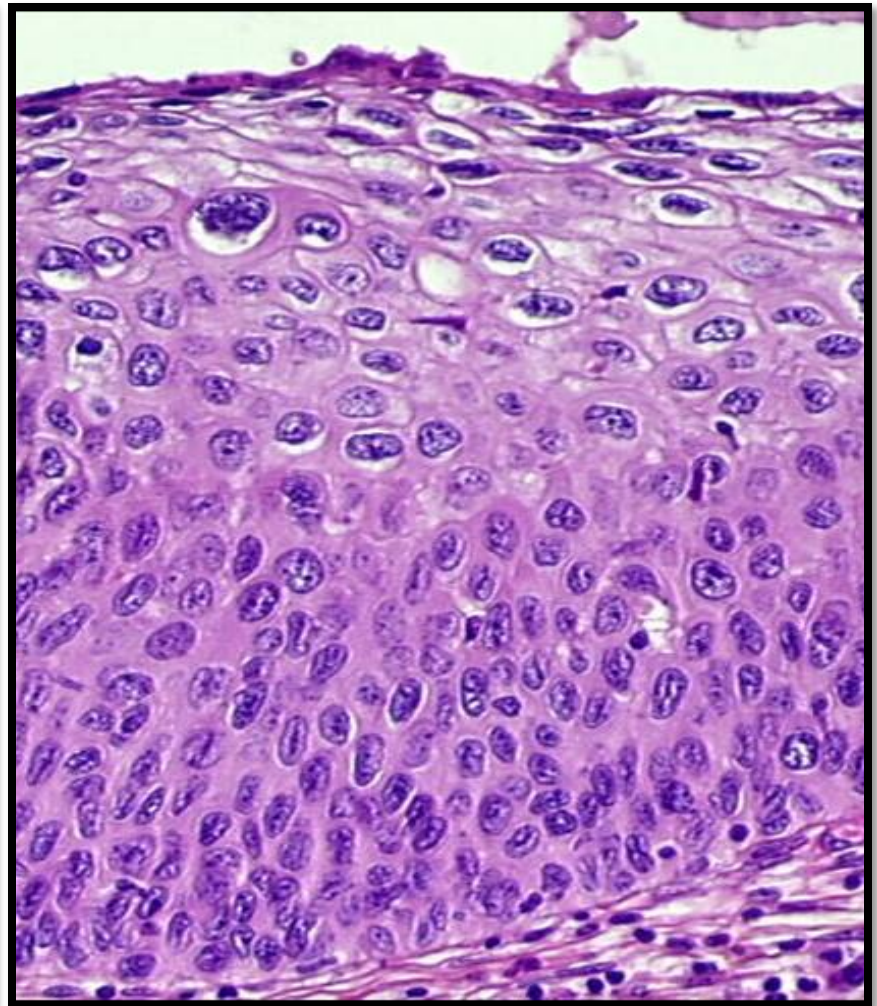
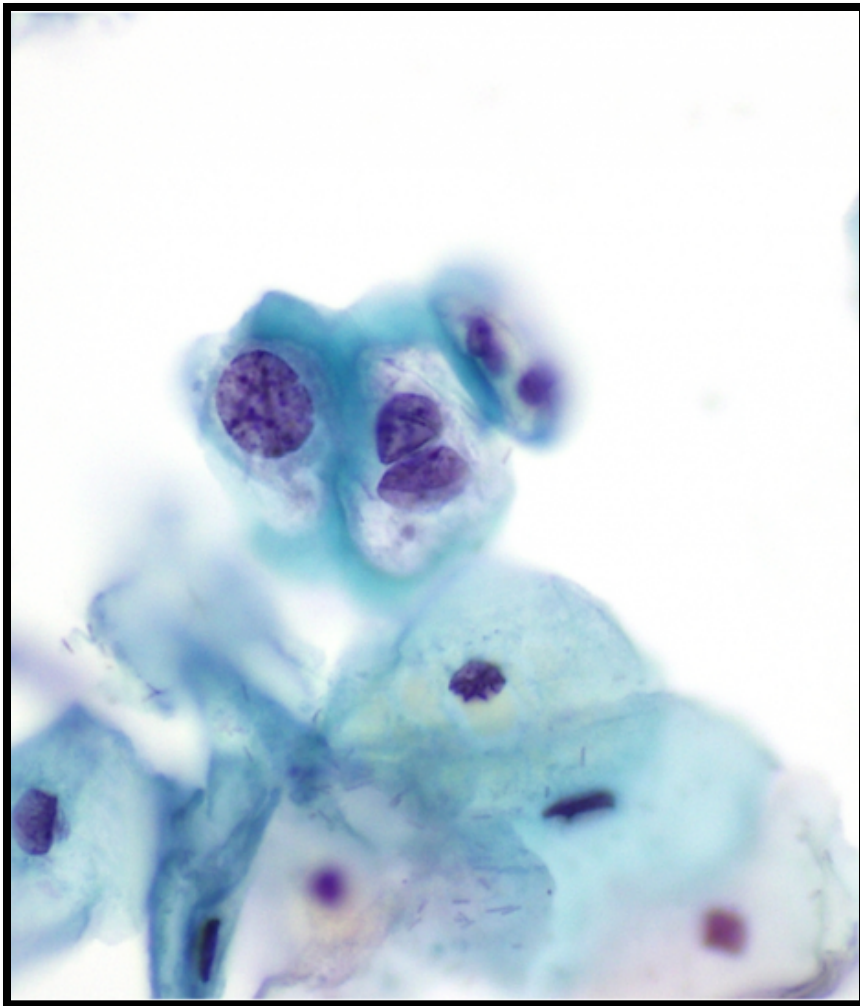
Dysplasia

- 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, \uparrow N:C ratio, hyperchromasia, irregular nuclei, increased mitoses, loss of polarity & a disordered maturation or total failure of maturation.

Dysplasia

- 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

Dysplasia



Dysplasia

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

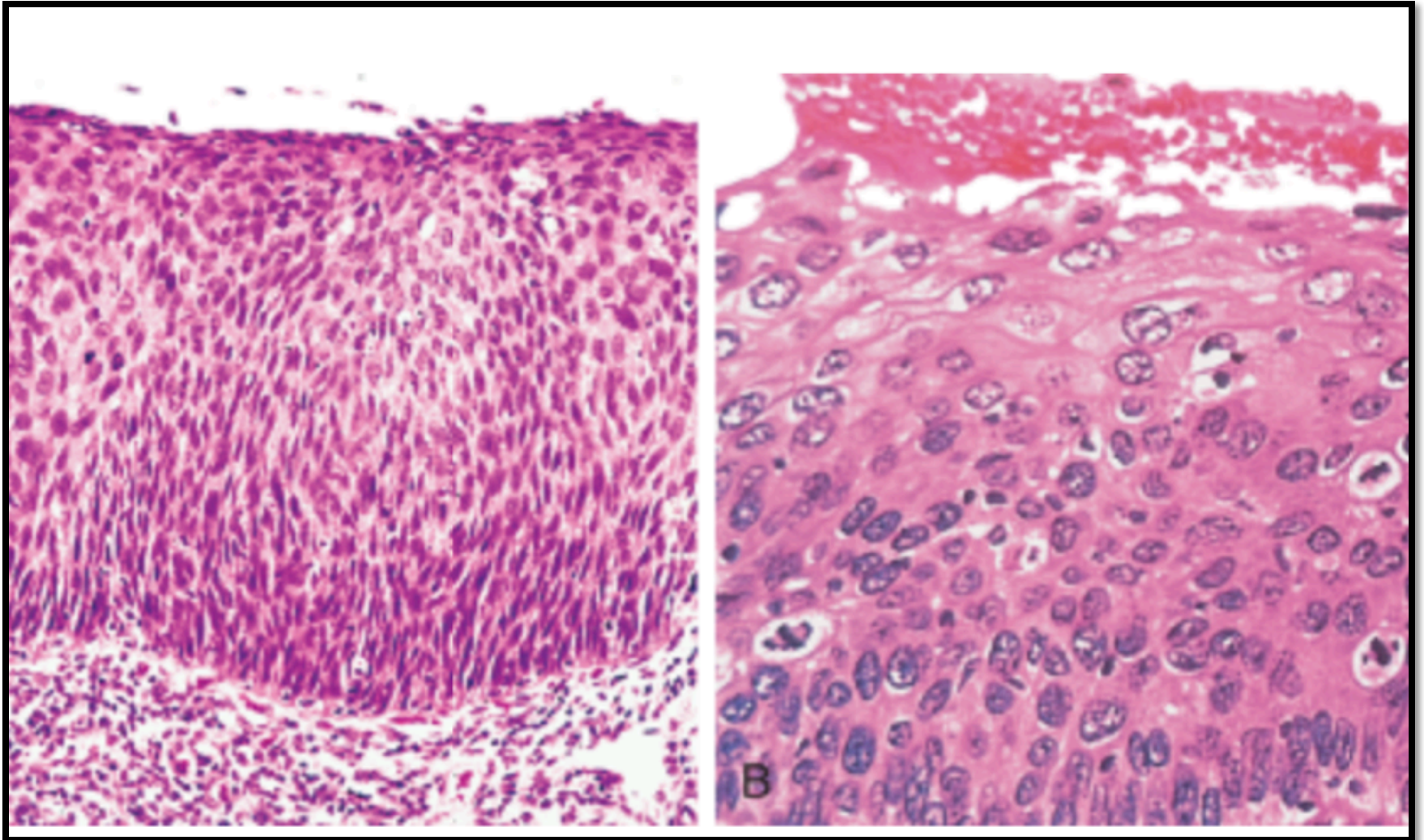
Carcinoma in Situ

- 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.

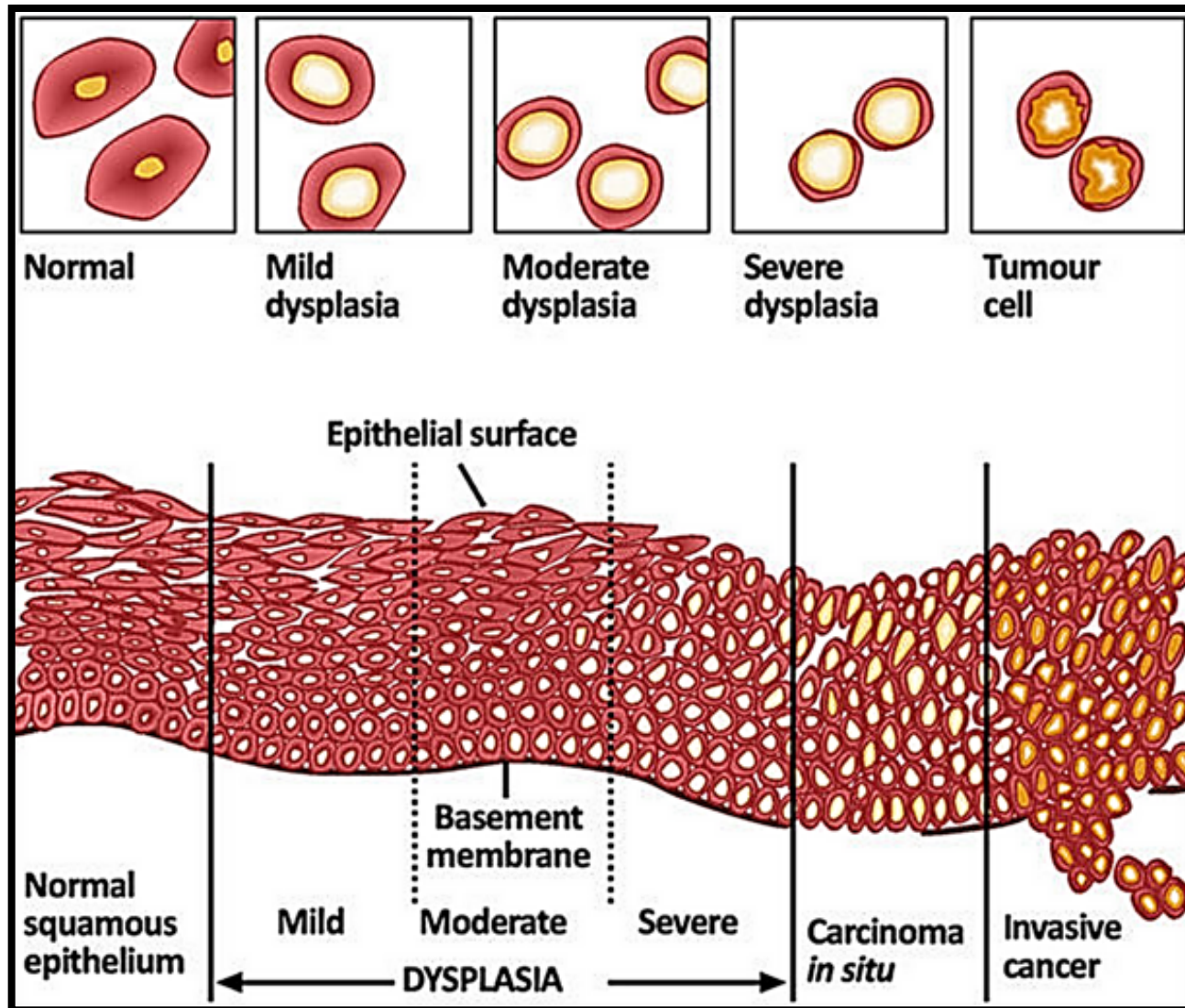
Carcinoma in Situ

- 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.

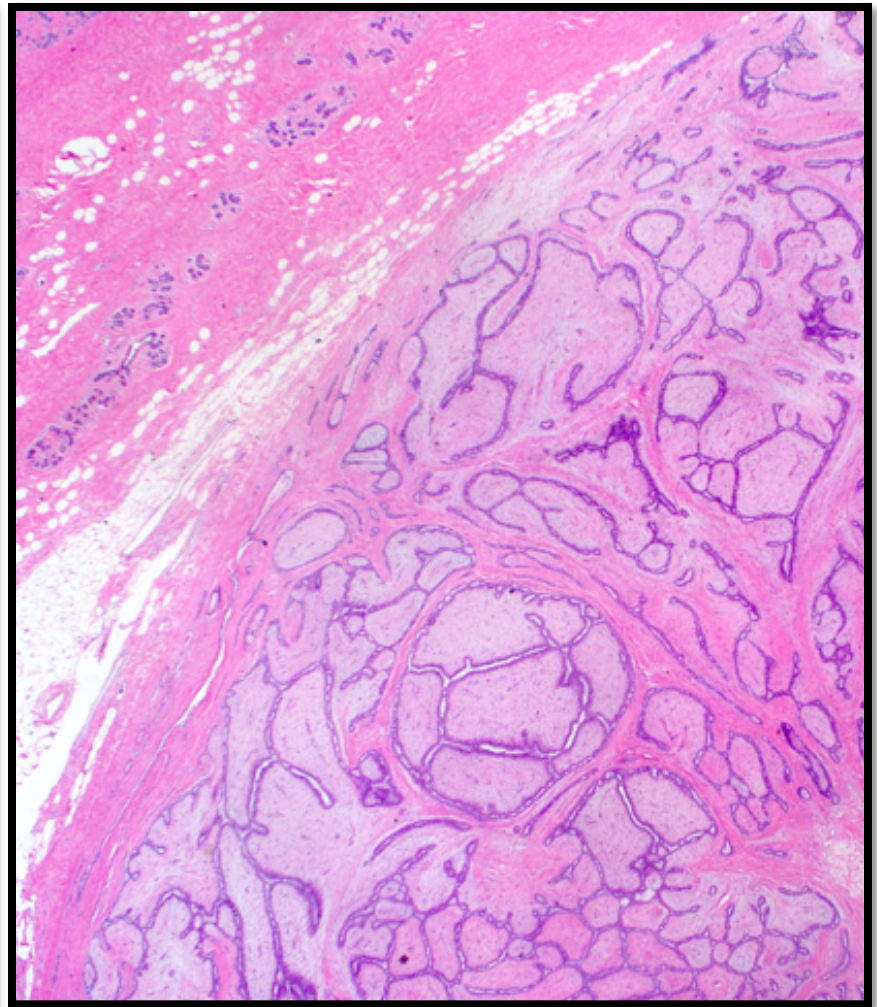
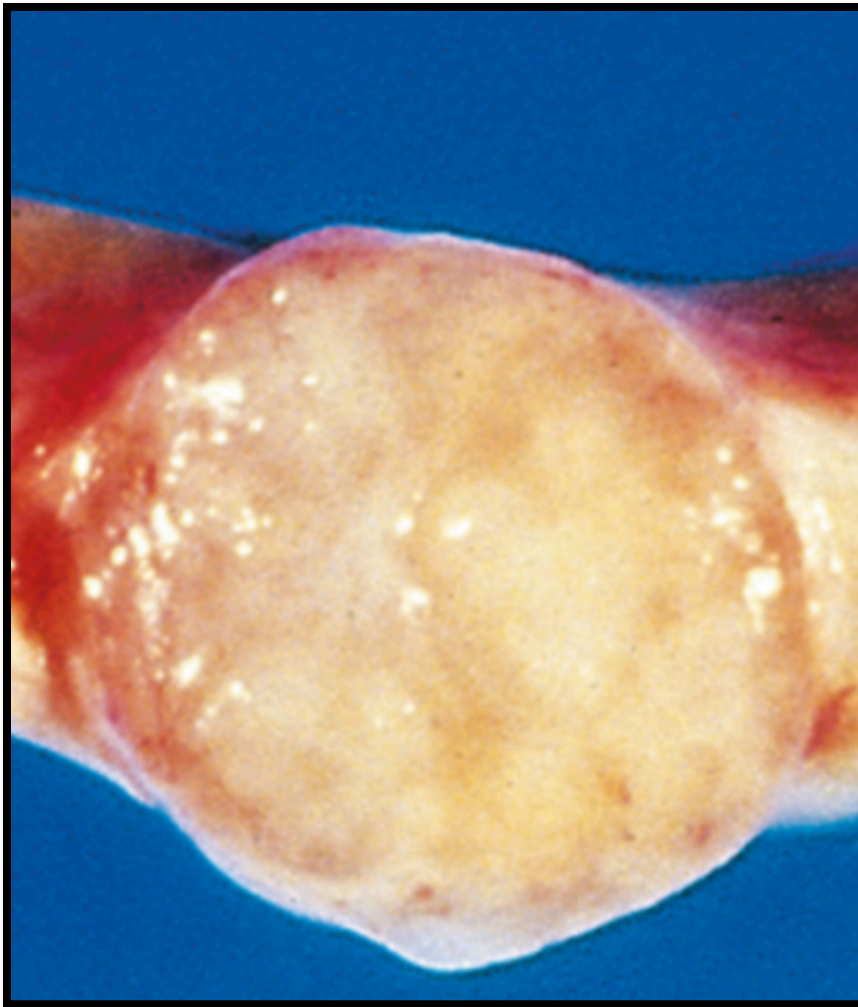
Rate of Growth

- 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.

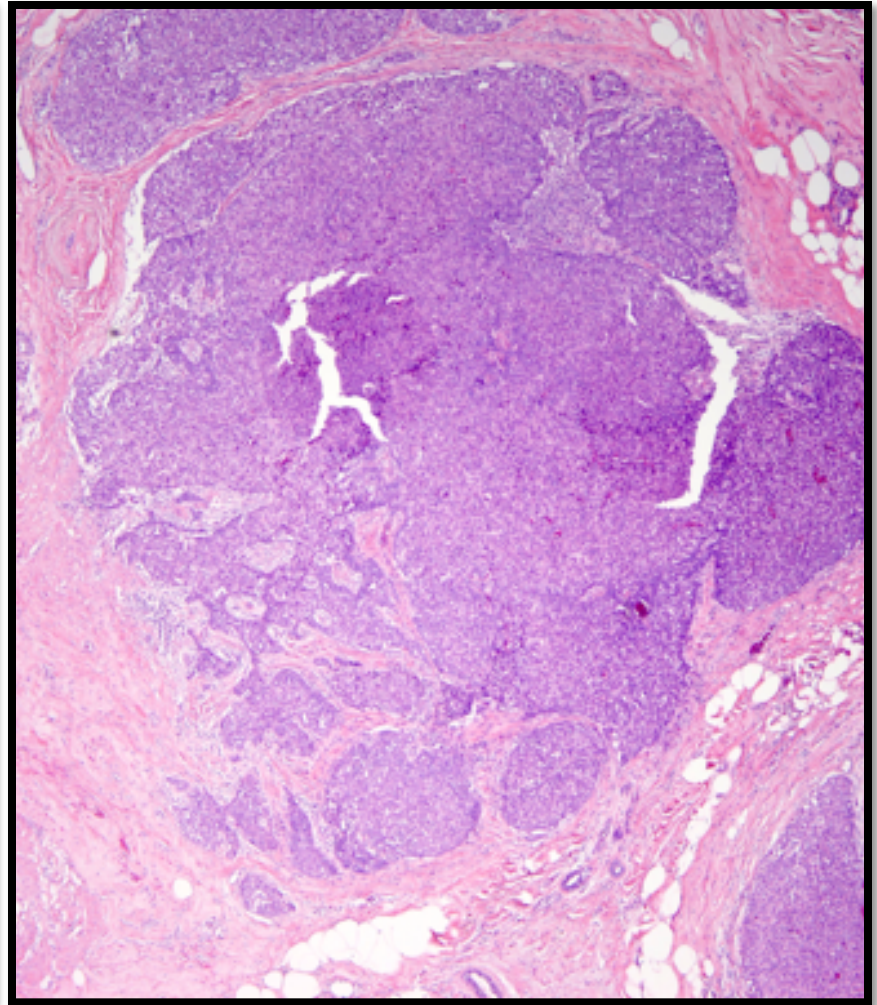
Local Invasion



Local Invasion

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

Local Invasion*



Metastasis

- 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.

Metastasis

- 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.

Metastasis

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

Metastasis

- 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.

Metastasis

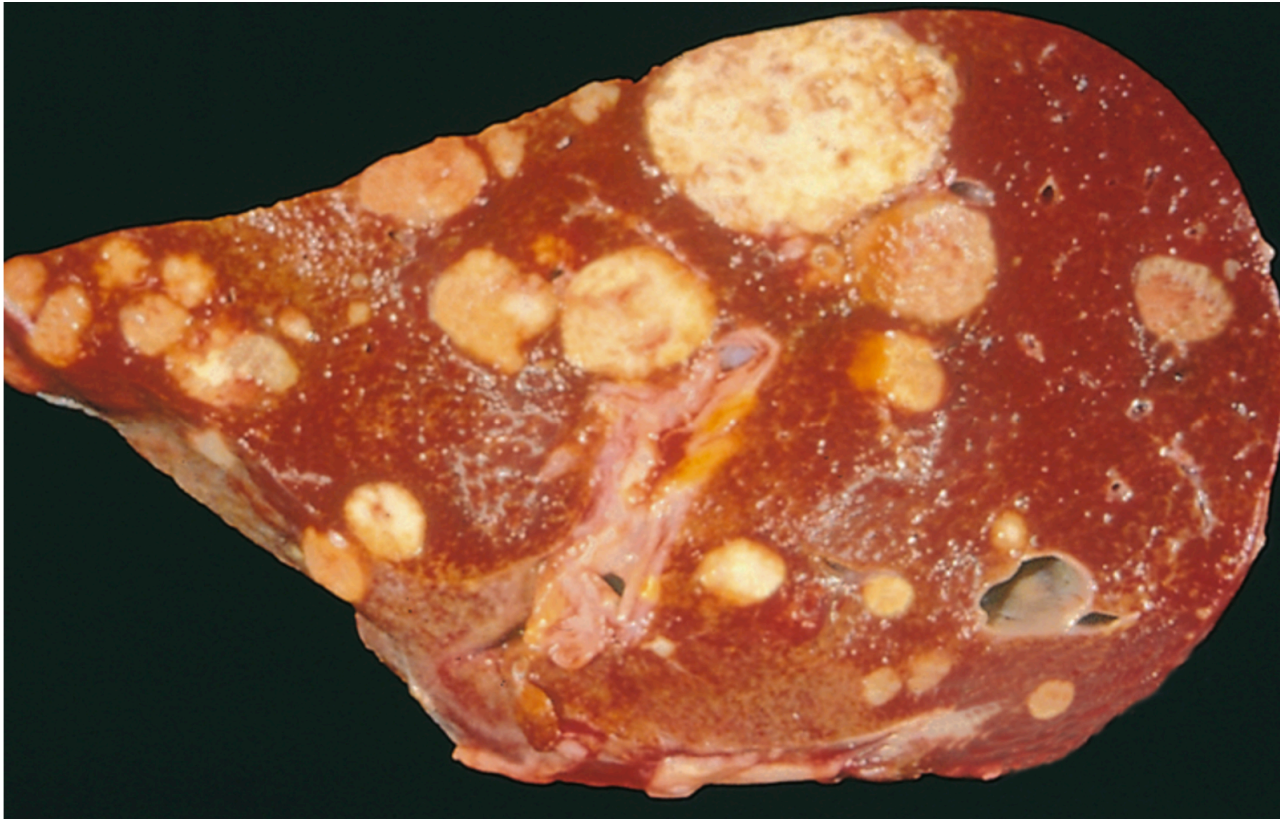
- Lymphatic spread is more typical of carcinomas.
 - Breast carcinoma → axillary lymph node
 - Lung carcinomas → bronchial lymph nodes

Metastasis

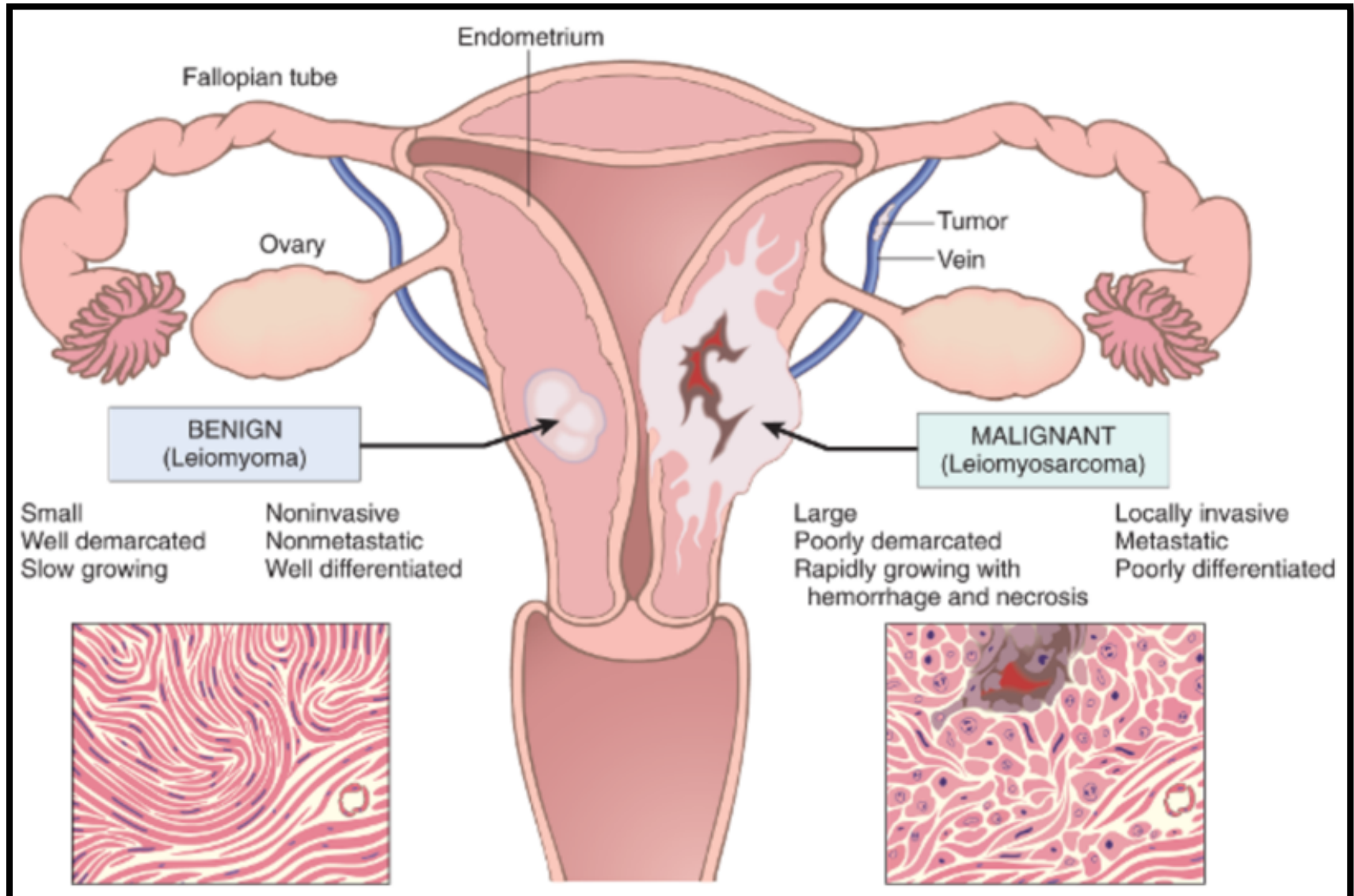
- Hematogenous spread is favored by sarcomas but can also occur in carcinomas.
- Veins are more commonly invaded.

Metastasis

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



Summary



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.

Reference

- Kumar V, Abbas AK, Aster JC. Robbins Basic Pathology. 10th ed. Elsevier; 2018. Philadelphia, PA.

END OF LECTURE

Thank You