

# NEOPLASIA

## Part 2

(Characters of benign and malignant tumors)

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# Outlines

- **Morphology (structure) of benign and malignant tumors.**
- **Behaviour of benign and malignant tumors.**
- **Grading and staging of malignant tumors.**
- **Complications of benign and malignant tumors (effects on the host).**
- **Causes of death in malignant tumors.**
- **Differences between benign and malignant tumors**

# **Morphology (structure) of benign and malignant tumors**

# Morphology of tumors

## I. Gross appearance

Size, shape, surface, consistency, cut section and color

## I. Microscopic features

### ➤ Tumor cells (parenchyma)

- *Growth pattern*
- *Cellular features*

### ➤ Tumor stroma

### ➤ Tumor vasculature

# Morphology of tumors

## I. Gross appearance

- **Benign tumors:** commonly appears as


- *Mass*
  - *Polyp*




*Describe size, shape, surface and cut section*

- **Malignant tumors:** could appears as


- *Mass*
  - *Polypoid (cauliflower)*
  - *Ulcer*
  - *Annular*




*Describe size, shape, surface and cut section*



*Describe size, shape, surface and cut section*



*Describe size, edge, base and floor*



*In hollow organs: thick wall and narrow lumen*



# Morphology of tumors

## II. Microscopic features

- Tumor cells (parenchyma): The proliferating cells
  - A. Growth pattern (low power).
  - B. Cellular features (high power).
- Tumor stroma
- Tumor vasculature

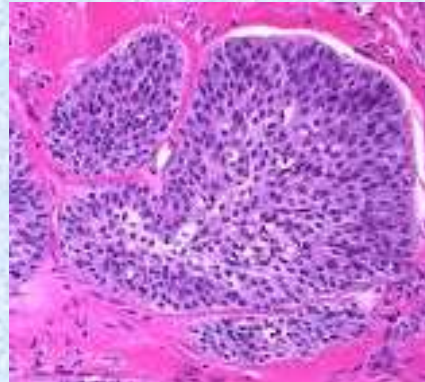
# Morphology of tumors

## II. Microscopic features

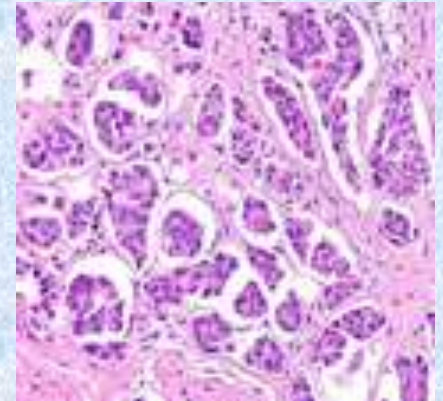
- Tumor cells (parenchyma): The proliferating cells

### A. Growth pattern

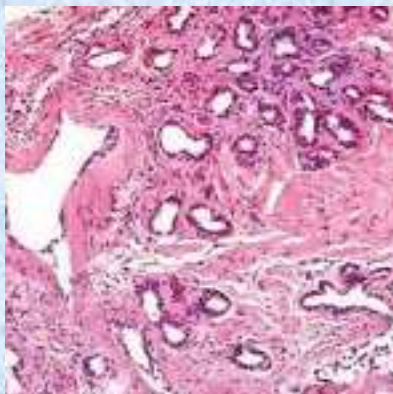
#### 1. Epithelial tumors:



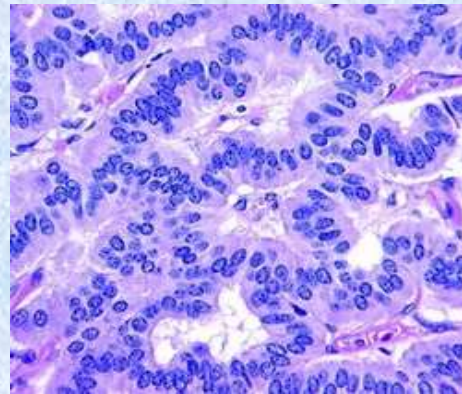
Sheets



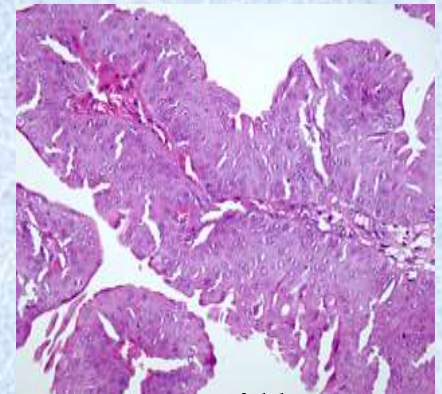
Nests



Acini



Glands



Papillae



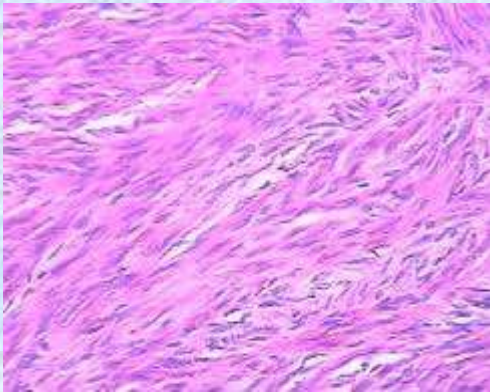
# Morphology of tumors

## II. Microscopic features

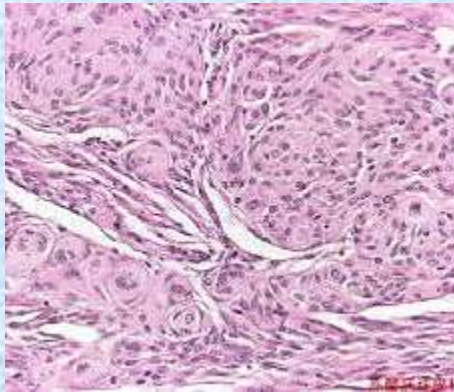
- Tumor cells (parenchyma): The proliferating cells

### A. Growth pattern

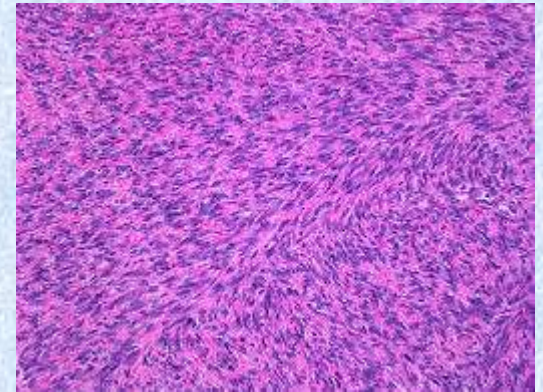
#### 2. Mesenchymal tumors:



Bundles



Whorl



Diffuse



# Morphology of tumors

## II. Microscopic features

- Tumor cells (parenchyma): The proliferating cells

### A. Growth pattern

### B. Cellular features

#### *a. Differentiation:*

- To what extent the neoplastic cells resemble native cells
- In benign tumors; the neoplastic cells closely resemble the native cells (well-differentiated)
- In malignant tumors: the neoplastic cells have a wide range of differentiation from **well-differentiated** to **undifferentiated** cells (anaplastic).
- Anaplasia: Means complete loss of differentiation

# Morphology of tumors

## II. Microscopic features

- Tumor cells (parenchyma): The proliferating cells

### A. Growth pattern

### B. Cellular features

#### *b. Cellular criteria of malignancy:*

- Loss of polarity
- Pleomorphism
- Hyperchromatism
- High nucleo-cytoplasmic (N/C) ratio
- Prominent nucleoli
- High mitotic rates
- Abnormal mitotic figures
- Tumor giant cells

# Morphology of tumors

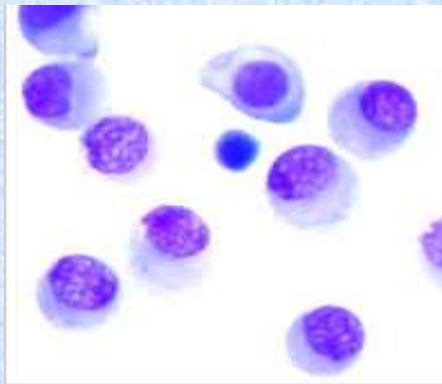
## II. Microscopic features

- Tumor cells (parenchyma): The proliferating cells

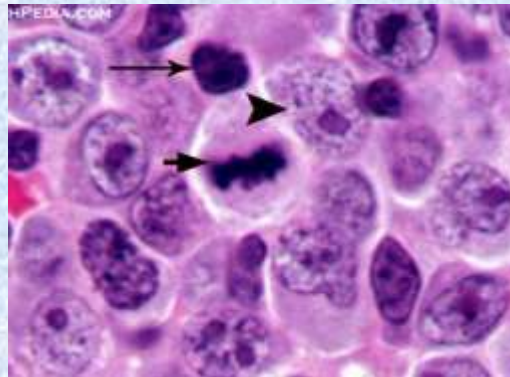
A. Growth pattern

B. Cellular features

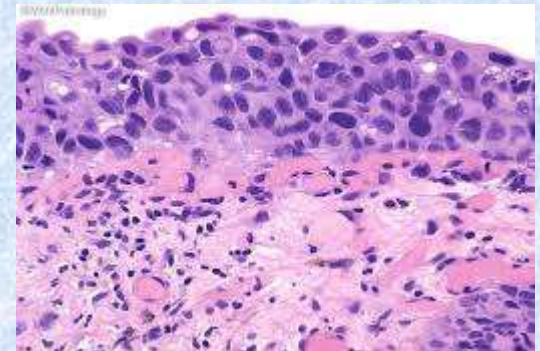
*b. Cellular criteria of malignancy:*



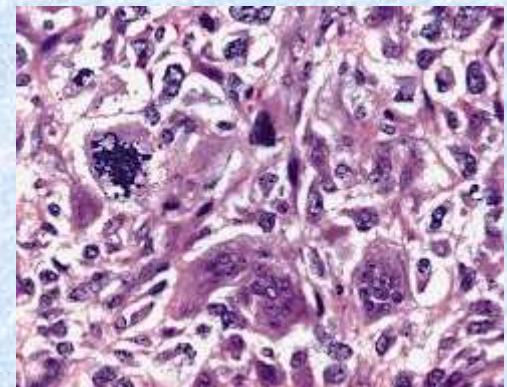
High N/C ratio



Mitosis &  
prominent nucleoli



Loss of polarity



Tumor giant cells



# Morphology of tumors

## II. Microscopic features

- **Tumor stroma.**
  - Fibro-collagenous or connective tissue material between individual tumor cells (in mesenchymal tumors) or between groups of tumor cells (in epithelial tumor).
  - May be absent or scanty as in lymphoma and sarcoma
  - May be abundant (desmoplastic) as in carcinomas
  - Evoked by basic fibroblast growth factor (b-FGF)
- **Tumor vasculature:** Tumor cells stimulate angiogenesis of its own blood vessels by secretion of angiogenic factors or using chemokines secreted by inflammatory cells.

# **Behaviour of benign and malignant tumors**

# Behaviour of tumors

## I. Rate and mode of growth

### a. Benign tumors:

- Slow rate of growth
- Grow by expansion
- Some benign tumor are hormone dependent; so they can grow fast or regress based on hormone availability (as uterine leiomyoma)
- The tumor may regress due to insufficient vascular supply

### b. Malignant tumors:

- Grow rapidly
- Grow by infiltration of surrounding tissues
- Growth rate may exceed blood supply; so tumor necrosis occurs
- Poorly differentiated tumor grow faster than better differentiated tumors



# Behaviour of tumors

## II. Local invasion (direct spread)

### a. Benign tumors:

- Do not infiltrate adjacent tissues
- Usually has a capsule or a pseudo capsule separates it from surrounding tissues

### b. Malignant tumors:

- Usually infiltrate surrounding tissues
- Non capsulated
- Have ill-defined infiltrative borders.
- Well-differentiated tumors may look capsulated (e.g. follicular thyroid carcinoma), however invasion to adjacent tissues can be detected microscopically.

# Behaviour of tumors

## III. Distant spread (metastasis)

- **Means**: migration of tumour cells to organ or site away from primary site with formation of secondary tumour masses.
- ***It is the single sure sign of malignancy***
- **Benign tumors don't metastasize** but **malignant tumors do**.
- Some malignant tumors infiltrate adjacent tissues but have no ability to metastasize (called locally malignant tumors).
- Poorly differentiated tumors are more likely to metastasize compared to well-differentiated tumours
- About 1/3 of the tumors are metastatic at time of diagnosis

# **Grading and staging of malignant tumors**



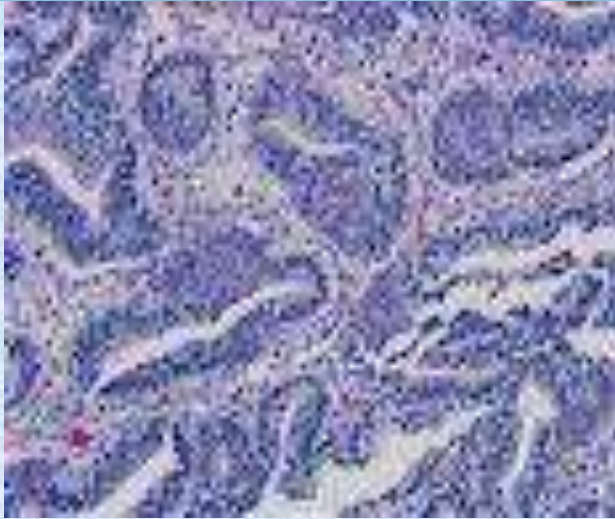
# Grading and staging

- Grading and staging are two methods to evaluate tumor severity
- They are very important for clinicians to standardize, plan and organize patients' treatment.

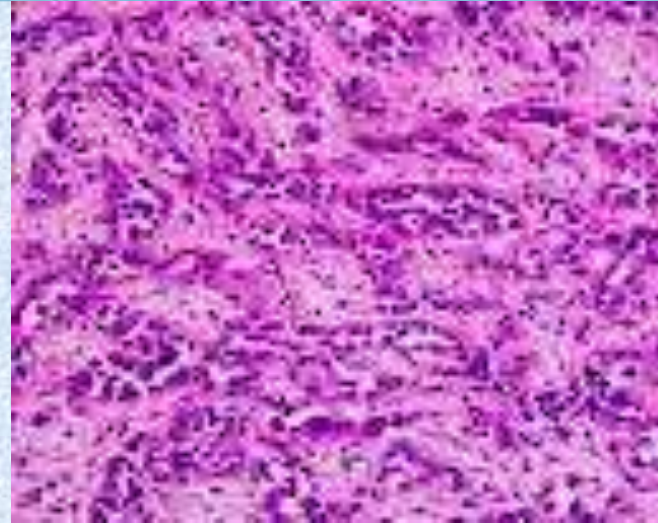
## A. Grading

- Based on degree of differentiation and number of mitosis.
- Cancer may be classified as
  - Grade I**: well-differentiated
  - Grade II**: Moderately differentiated
  - Grade III**: poorly differentiated
  - Grade IV**: undifferentiated or anaplastic
- Higher-grade tumors are aggressive than lower grade ones.
- Of note that within the same tumor, cells have different stages of differentiation. The final grade of a tumor depends on percentage of the dominant cells.

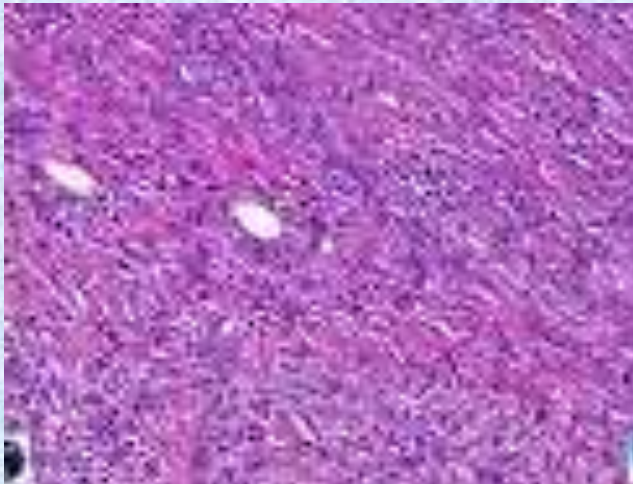
# Grading and staging



**Grade I**



**Grade II**



**Grade III**



**Grade IV**

**Tumor grade (differentiation)**

# Grading and staging

## B. Staging

- Based on anatomic extent of the tumor,  
i.e. size and degree of local and distant spread of the tumor
- Can be evaluated clinically, radiologically or surgically



# Grading and staging

## B. Staging

- The commonly used is **TNM** staging system:
  - **T**: refers to primary tumor, and classified to T1, T2, T3 and T4 based on tumour size and extent of local spread
  - **N**: refers to lymph node spread and classified to N0, N1, N2 and N3 based on the number of involved LNs
  - **M**: refers to distant metastasis, and classified to M0 and M1 refer to absence or presence of metastasis, respectively
- Staging is related to behaviour and prognosis of tumors:
  - Tumor confined entirely within an organ can be cured surgically.
  - Local or distant spread worsens the prognosis.

**Complications: Effects of  
benign and malignant tumors  
on the host**

# Complications of tumors

- **Complications of benign tumors:**

- *Usually few and mostly insignificant*

- *A benign tumour can be dangerous if:*

- Hormone-producing: pituitary adenoma, thyroid adenoma or pheochromocytoma.

- Arise in, and obstruct a hollow organ:

- Oesopagus: dysphagia
- Intestine: intestinal obstruction
- Bile duct: obstructive jaundice

- Arise in vital organ:

- vertebral column → paraplegia
- brain tumours (glioma and meningioma) → increased intracranial tension.

- Malignant change: featured by increased rate of growth, infiltrate nearby structures, cellular features of malignancy and metastasis.

# Complications of tumors

- **Complications of malignant tumors:**

- *Common and usually serious*

- *Include:*

1. **Infiltration** of the surrounding tissues
2. Spread to distant organs (**metastasis**): commonly to **L**ymph nodes, **L**ung, **L**iver, **B**one and **B**rain.
3. **Recurrence** after surgical removal
4. **Obstruction**: common in tumors arising in hollow organs.
5. **Pressure symptoms**: as increased intracranial tension or obstructive jaundice
6. **Ulceration & hemorrhage**: common in tumors of surface epithelium



# Complications of tumors

**7. Repeated secondary bacterial infection.**

**8. Anemia:** due to repeated hemorrhage, bone marrow involvement or malnutrition

**9. Persistent pain:** in primary sites and bone pain in metastatic tumours.

**10. Secondary amyloidosis:** in certain tumors as multiple myeloma and medullary thyroid carcinoma.

**11. Malignant cachexia:**

- Means marked weakness, wasting and weight loss.
- Caused by chronic anemia, malnutrition, repeated infection, toxemia and organ failure.
- Release of tumor necrosis factor (TNF) & Interleukin play important role in pathogenesis.

# Complications of tumors

## 12. Para-neoplastic syndromes:

- **Means:** Symptoms and signs caused by abnormal products of tumor cells but not by local effects of the tumor
- **Examples:**
  - *Endocrine effects: e.g.*
    - Bronchogenic carcinoma and pancreatic carcinoma → ACTH → Cushing syndrome
    - Carcinoid tumour of appendix and bronchial adenoma → serotonin and bradykinin → carcinoid syndrome
    - Pheochromocytoma → epinephrine and norepinephrine → hypertension
  - *Neuropathic effect:* pulmonary, gastric, and breast tumours may be accompanied with progressive neuron destruction leading to neurological symptoms.

# Complications of tumors

- *Causes of death in malignant tumors*

- 1. Organ failure**

- Local organ failure due to direct infiltration
- Distant organ failure due to metastasis (hepatic or respiratory failure).

- 2. Obstruction of hollow organ**

- Intestinal obstruction
- Ureteric obstruction leading to renal failure
- Obstructive jaundice leading to liver cell failure

- 3. Involvement of CNS** by primary or secondary tumours.

- 4. Malnutrition:** due to loss of appetite or mal-absorption

# Complications of tumors

- *Causes of death in malignant tumors*

- 5. **Anemia**, caused by:

- Malnutrition
    - Metastasis in bone marrow
    - Ulceration and bleeding by the tumour
    - Folic acid or iron deficiency caused by high tumour cell metabolism

- 6. **Malignant cachexia** (see before)

- 7. **Paraneoplastic syndrome** (see before)



## • Differences between benign and malignant tumors

Item	Benign	Malignant
<b>Rate of growth</b>	Usually slow	Usually rapid
<b>Mode of growth</b>	Expansion	Infiltration
<b>Gross features</b> <ul style="list-style-type: none"> <li>• <b>Outlines</b></li> <li>• <b>Capsule</b></li> <li>• <b>Size</b></li> <li>• <b>Consistency</b></li> <li>• <b>Hemorrhage</b></li> <li>• <b>Necrosis</b></li> <li>• <b>Ulceration</b></li> <li>• <b>Surrounding tissue</b></li> </ul>	Defined Usually capsulated Variable Soft to firm Very rare or absent Very rare or absent Very rare or absent Compressed	Irregular/ill-defined Non capsulated Variable Firm to hard Common Common Common Infiltrated

## • Differences between benign and malignant tumors

Item	Benign	Malignant
<b>Microscopic features</b> <ul style="list-style-type: none"><li>• <b>Differentiation</b></li><li>• <b>Features of malignancy</b></li><li>• <b>Cellular function</b></li><li>• <b>Chromosomal changes</b></li></ul>	Well-differentiated Absent  Usually preserved Infrequent	Variably differentiated Often present  Usually disrupted Frequently present
<b>Local invasion</b>	Usually absent	Frequently detected
<b>Metastasis</b>	Absent	Frequently detected
<b>Prognosis</b>	Excellent; only local complications	Bad and fatal due to metastasis

**Good luck**

**Dr. Ahmed Roshdi**