# Genetics basis in carcinogenesis : Lec. 1

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# • Neoplasm # I : *Learning objectives*

- Outlines for Neoplasm #1

- Terminology
- Laboratory demonstration
- General features of neoplasm

## • Terminology review :

- Hypertrophy - increase in cell *size*
- Hyperplasia – increase in number of cells
- Metaplasia – cell type conversion

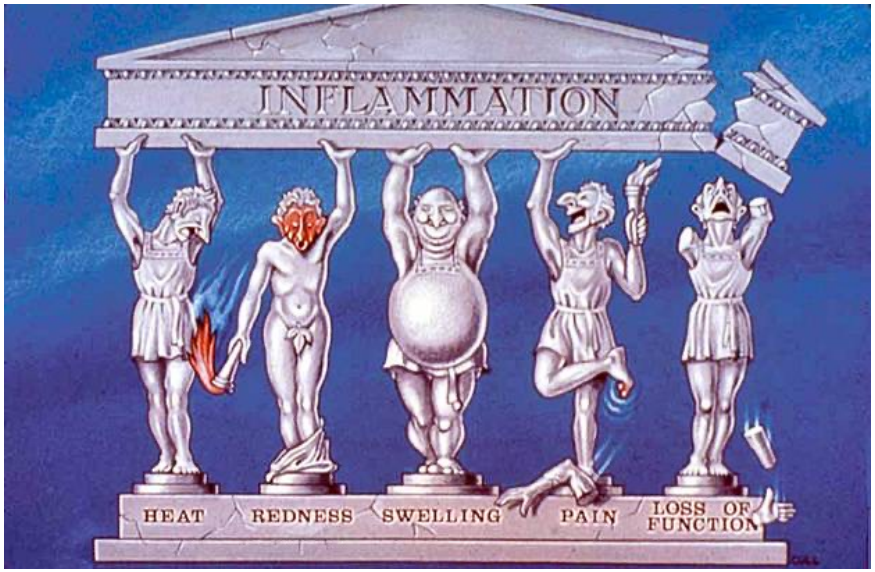
- Neoplasia – abnormal proliferation
- Dysplasia – maturation abnormality
- Anaplasia – dedifferentiation

- Desmoplasia – connective tissue growth

# Tumor *vs* Neoplasia

- Tumor (latin for *swelling*)
- originally meant all forms of swelling

**The Five Cardinal Signs of Inflammation**

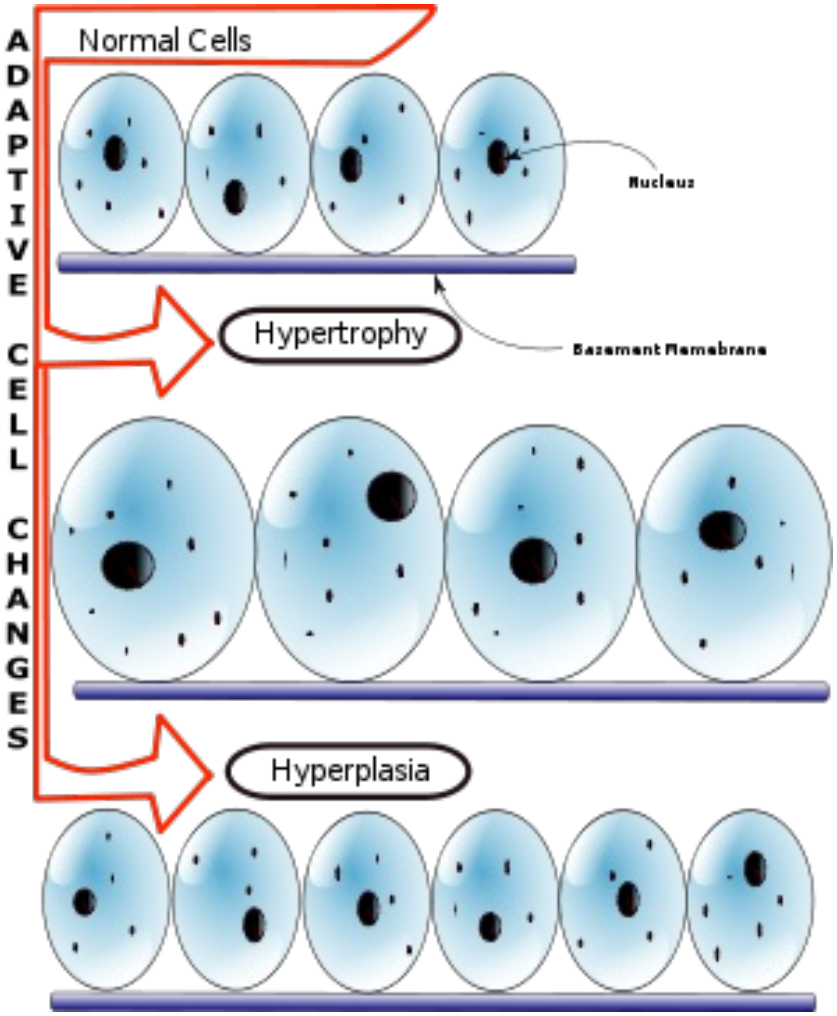


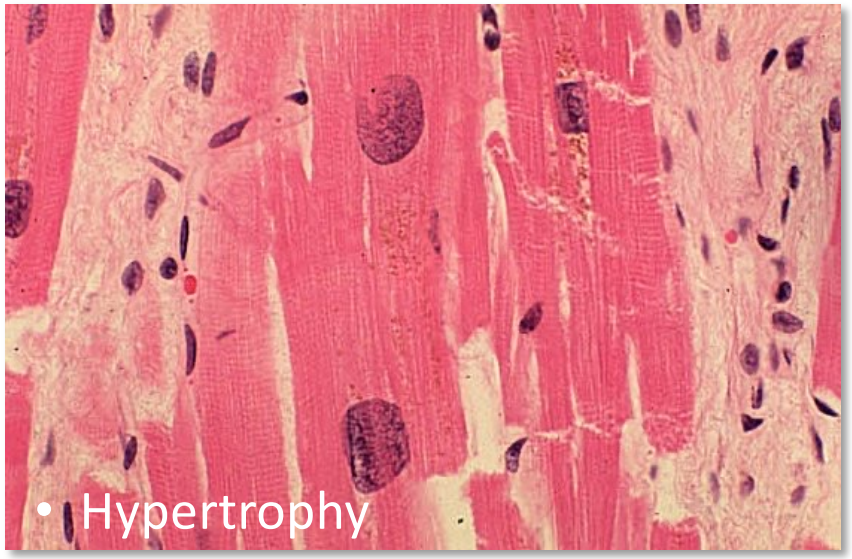

Calor –Rubor –Tumor -Dalor- Functio lose


Gouty arthritis

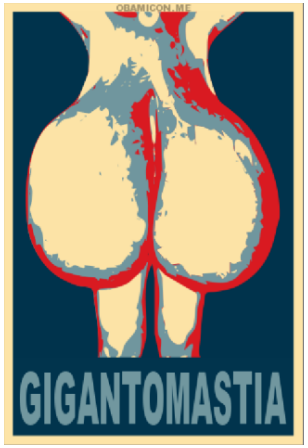
- **Tumor :** An abnormal growth of tissue.
- *Tumor* is now considered synonymous with *neoplasm* (Gr., *new growth*).

- Hypertrophy results from an increase in cell *size*, while hyperplasia is from an increase in cell number



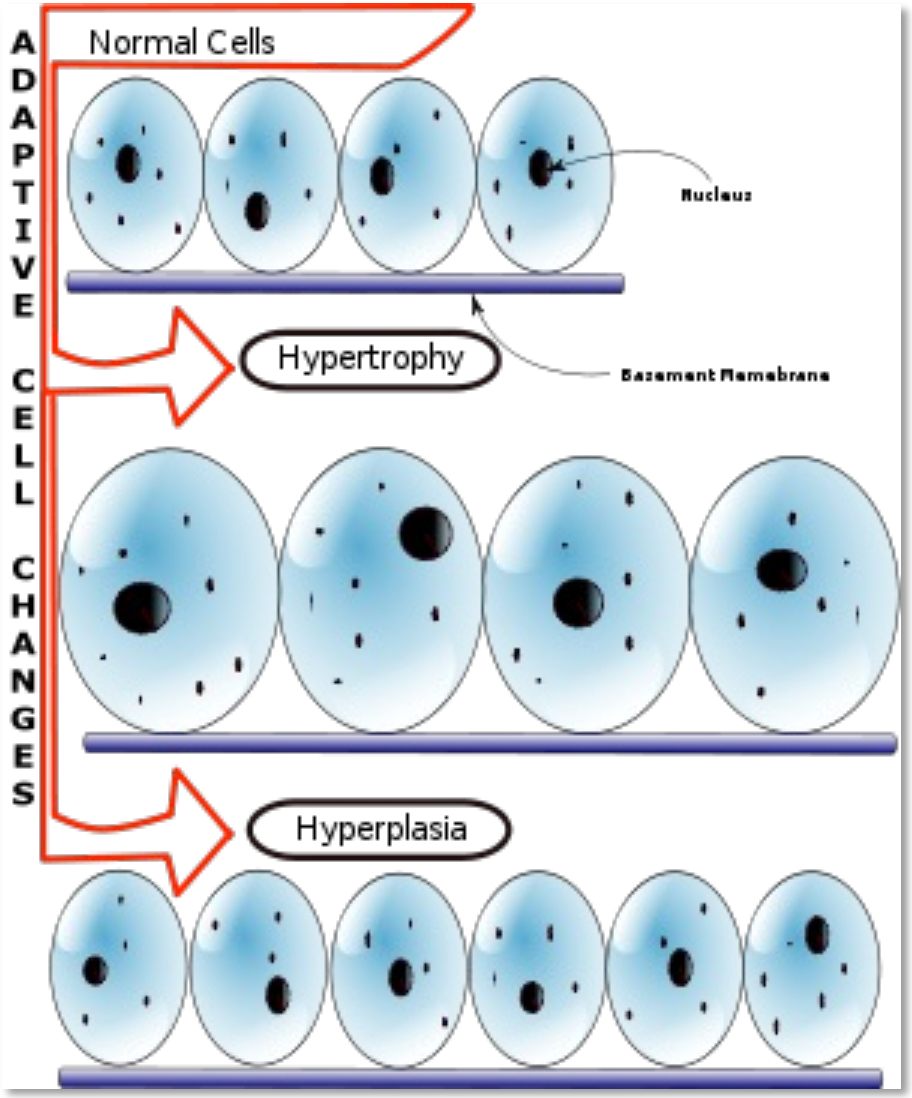



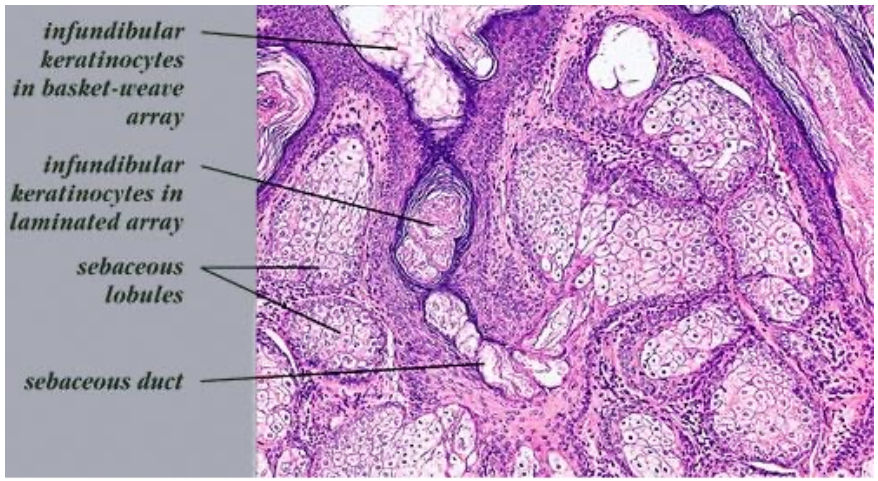
- Hypertrophy



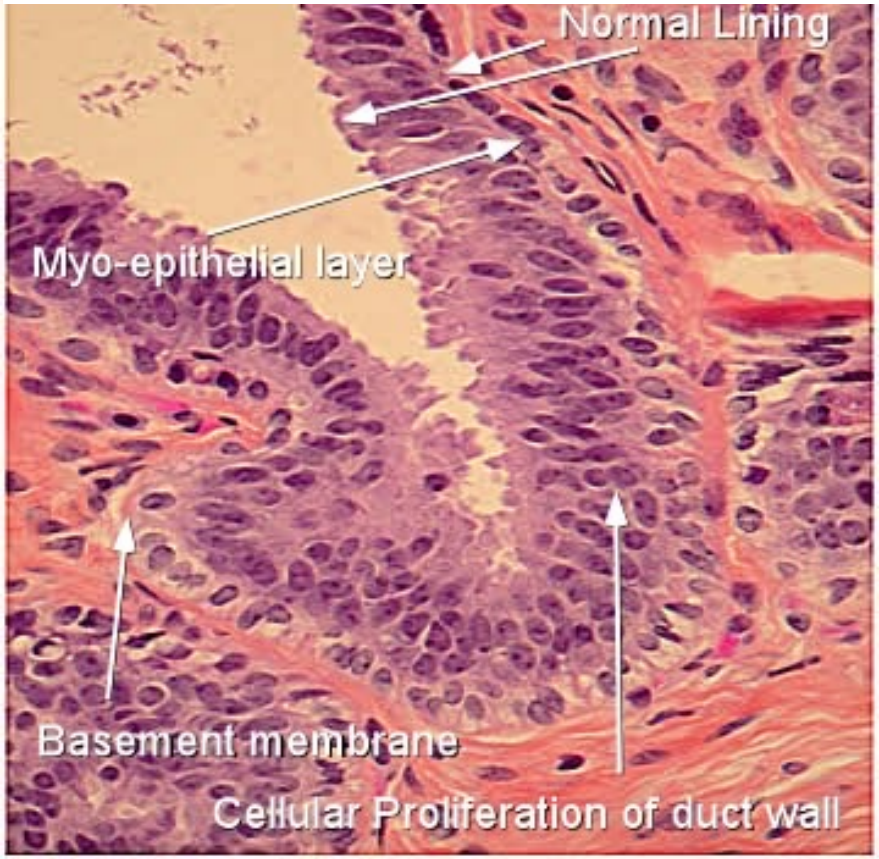

- Juvenile hypertrophy

- Hyperplasia results from an increase in cell *number.*



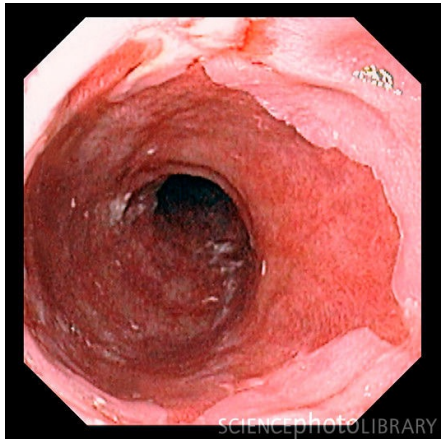

Acne : sebaceous gland hyperplasia

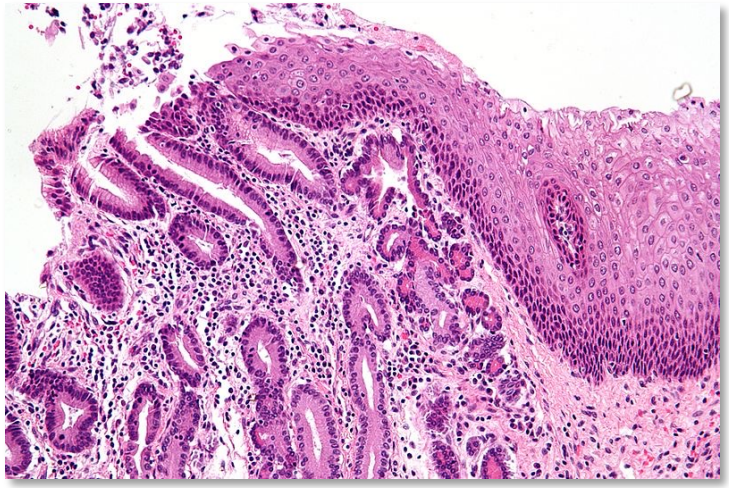


- **Metaplasia** (Greek: "change in form") is the reversible replacement of one differentiated cell type with another mature differentiated cell type.

| Tissue | Normal | Metaplasia | Stimulus |
|---|---|---|---|
| Airways | Pseudostratified columnar epithelium | Squamous epithelium | Cigarette smoke |
| Urinary bladder | Transitional epithelium | Squamous epithelium | Bladder stone |
| Esophagus | Squamous epithelium | Columnar epithelium | Gastro-esophageal reflux (Barrett's Esophagus) |
| Cervix | Glandular epithelium | Squamous epithelium | Low pH of vagina |

- Gastro-esophageal reflux



- Neoplasia ( Gr., *new growth*) is *the abnormal proliferation of cells.*

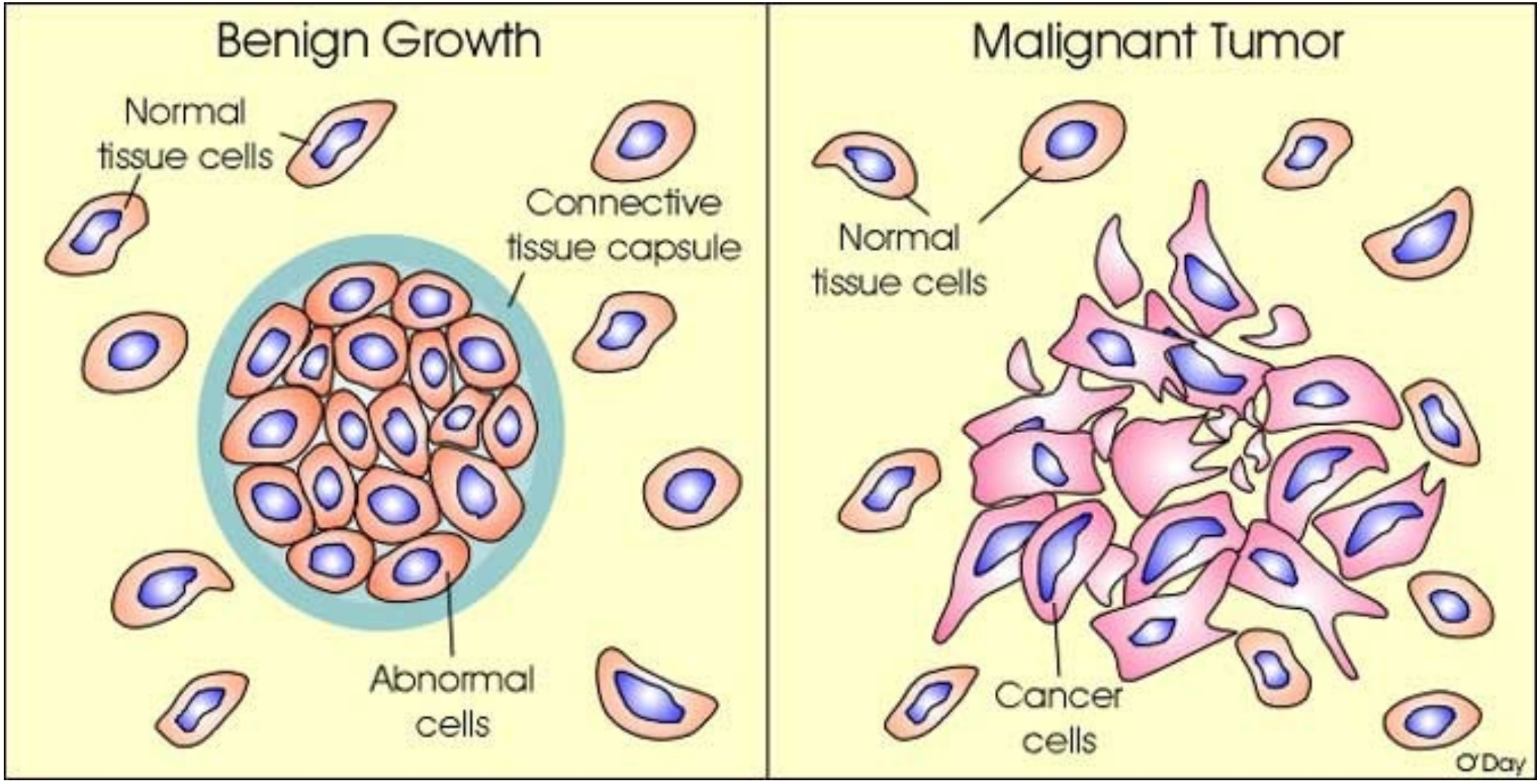
  - The growth of the cells exceeds, and uncoordinated with that of the normal tissues.

  - The growth persists in the same excessive manner even after cessation of the stimuli.

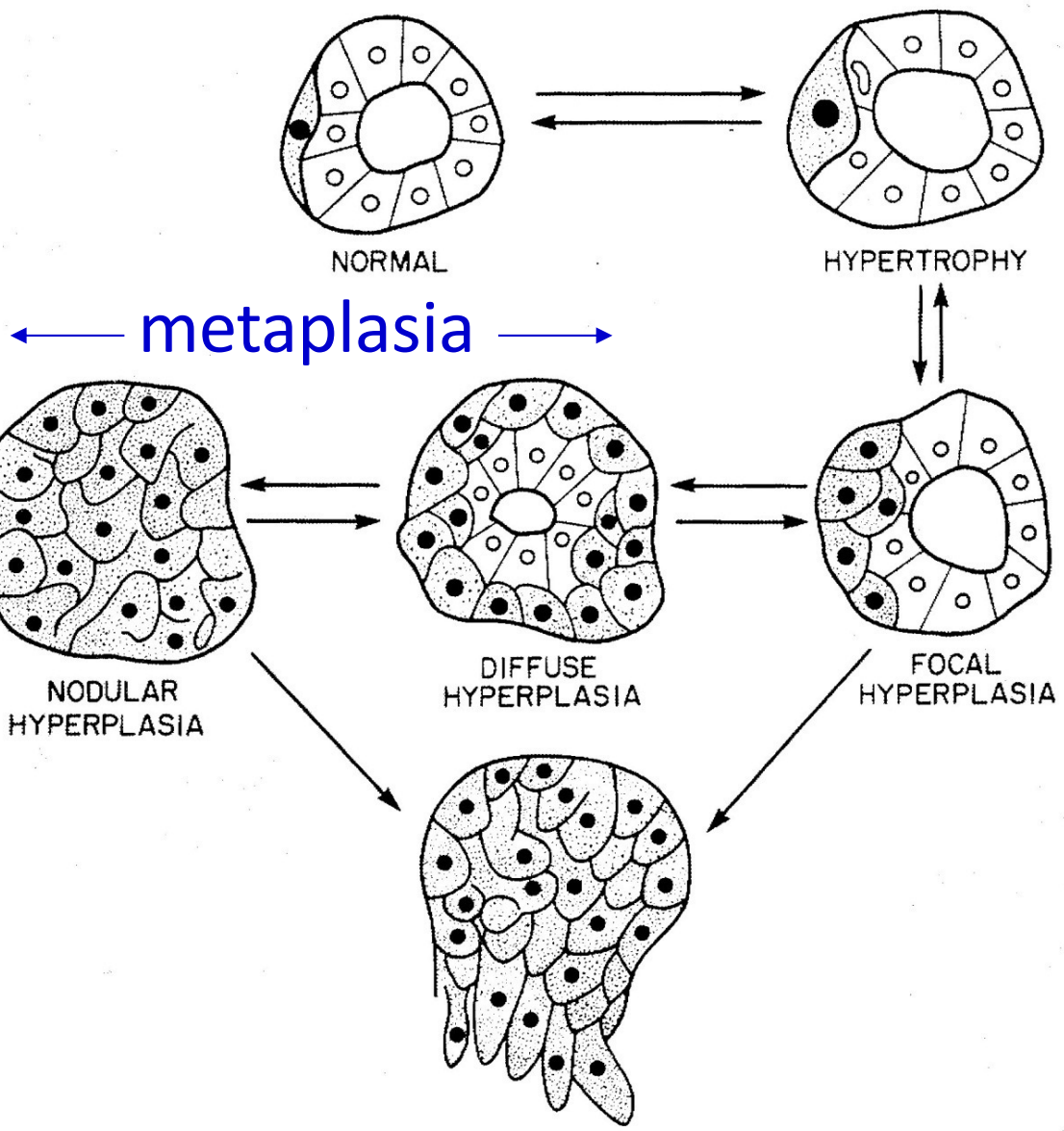
- Neoplasms may be
- benign neoplasms
- pre-malignant or precancerous lesions
- malignant neoplasms

| S. No. | Characteristics | Benign Neoplasm | Malignant Neoplasm |
|---|---|---|---|
| 1 | Cell Character | Well differentiated | Poor differentiate |
| 2 | Mode of Growth | Tumor growth by expansion | Tumor growth by infiltration |
| 3 | Rate of Growth | Slow Growth | Rapid Growth |
| 4 | Growth | Encapsulated | Not contain with in a capsule (Non-capsulated) |
| 5 | Metastasis (Transfer of a disease from one part of body to another through blood vessels or lymphatic channels) | Does not spread | Present |

- Different growth patterns in *benign* and *malignant* tumors



- Hyperplasia and metaplasia associated with tumorigenesis.



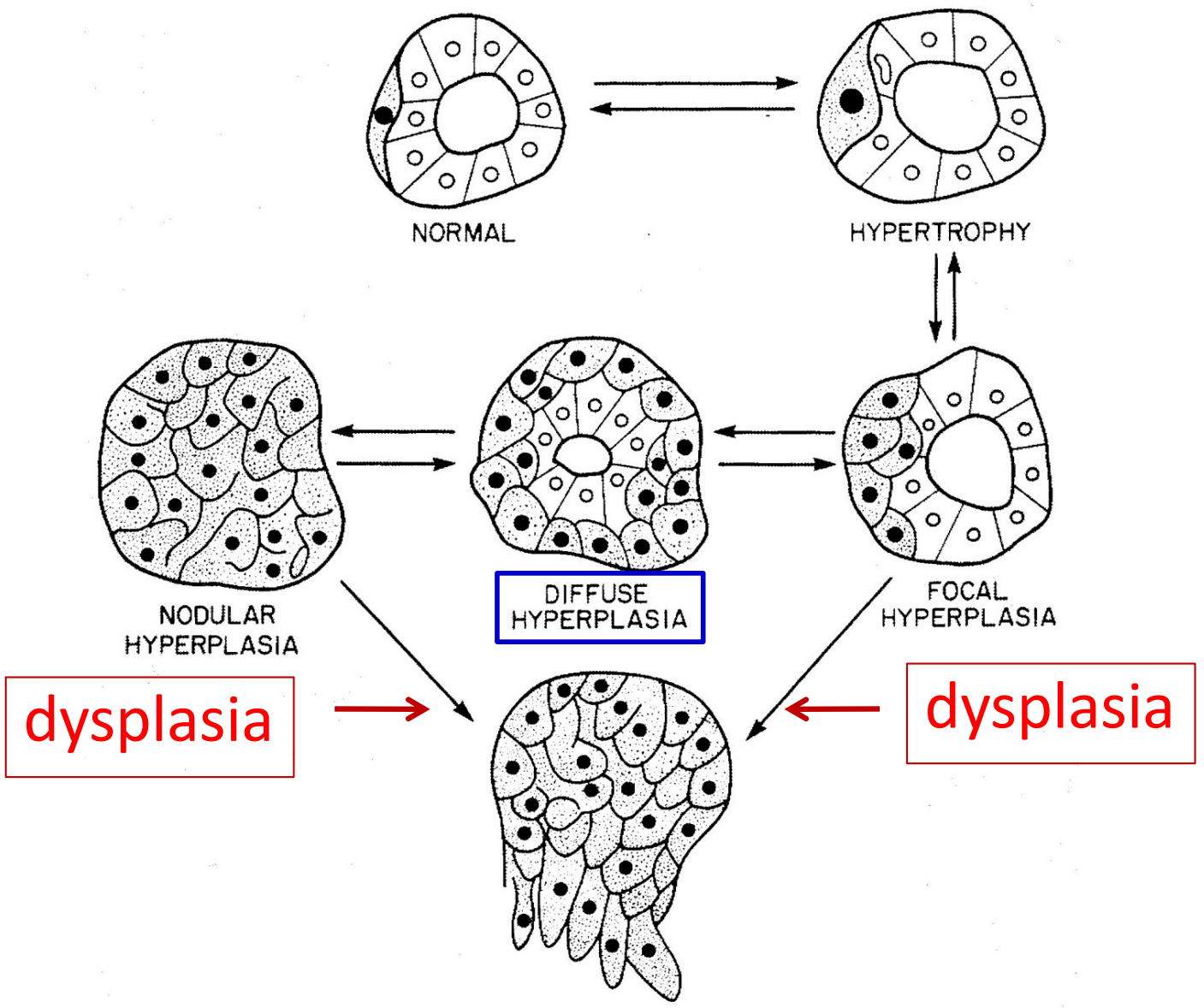

Benign neoplasms

- **Dysplasia** (Gr. “abnormal growth"), is referred to abnormality of cellular development.

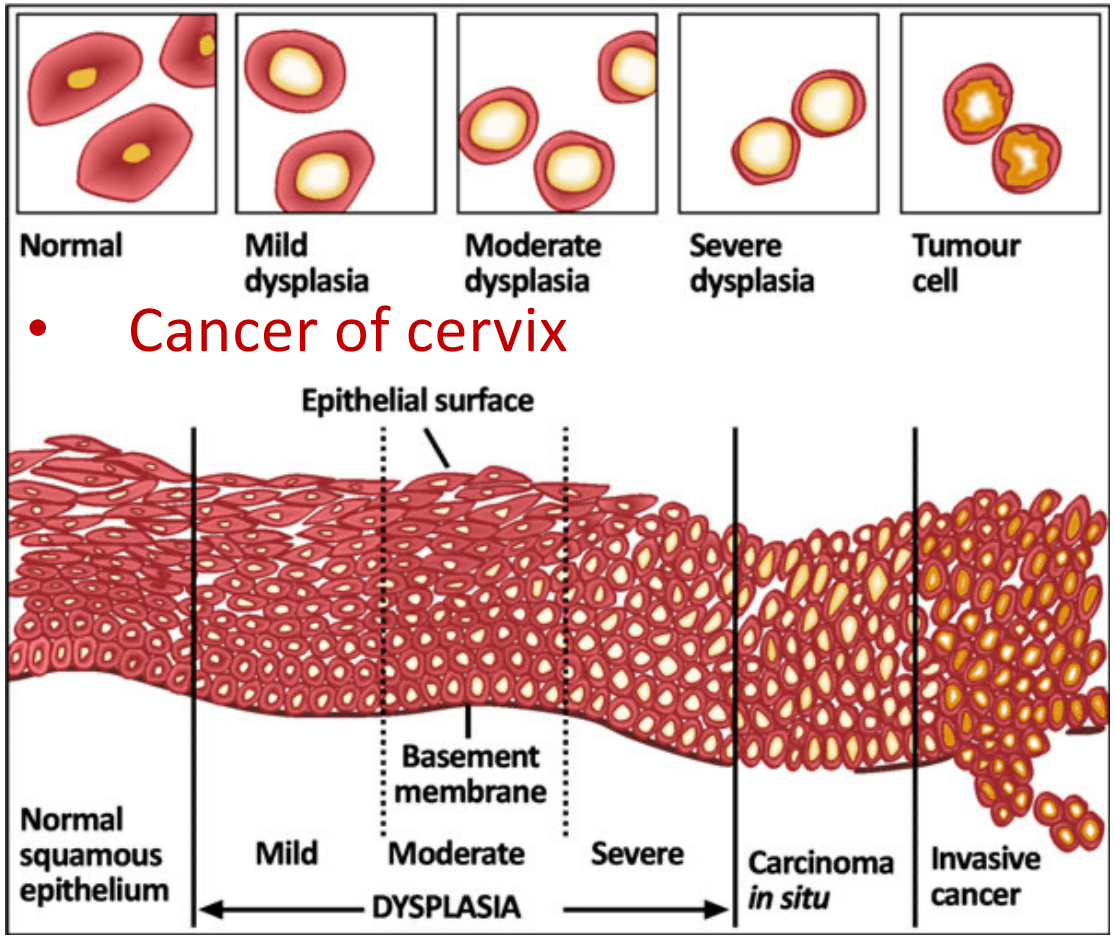
- Dysplasia, in which cell maturation and differentiation are delayed, can be contrasted with metaplasia, in which cells of one mature, differentiated type are replaced by cells of another mature, differentiated type.

- Dysplasia is often indicative of an early neoplastic process.

- Dysplasia is associated with tumorigenesis.



**Dysplasia** is a term refer to an abnormality of maturation.
It is typically used when the cellular abnormality is restricted to the originating tissue.

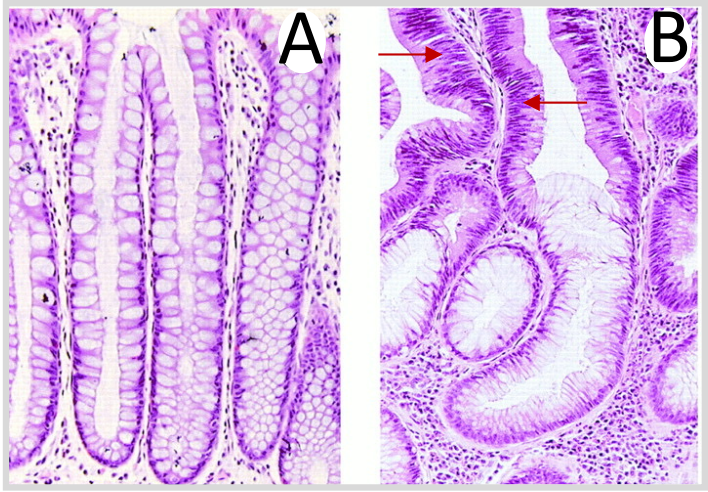



- Cancer of cervix

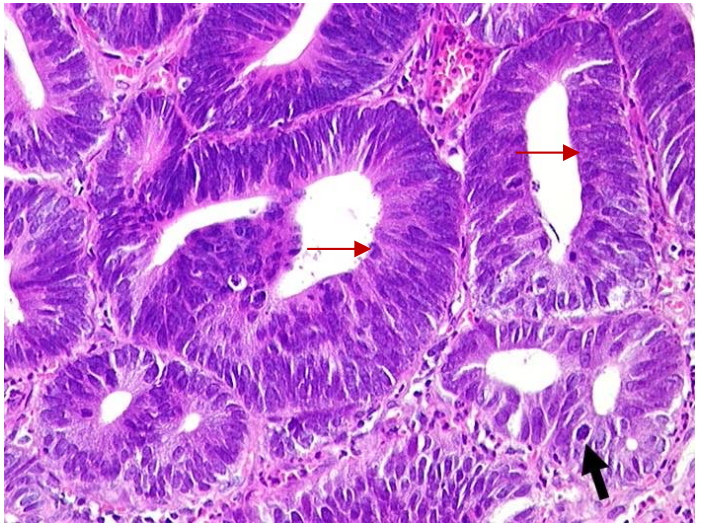



- Dysplasia is often indicative of an early neoplastic process.
- Dysplasia, in which cell maturation and differentiation are delayed.

- Cancer of colon




Dysplastic mucosa of colnic adenomas



Carcinoma *in situ*

•Anaplasia is the most extreme disturbance in cell growth encountered in the spectrum of cellular proliferations.

- Anaplastic cells (cancer cells) display marked pleomorphism.
- Anaplastic nuclei are variable and bizarre in size and shape.
- The nuclei are characteristically extremely hyperchromatic.
- The nuclear-cytoplasmic ratio may approach 1:1 .
- More important, mitoses are often .
- They may grow with total loss of communal structures, such as gland formation or stratified squamous architecture.

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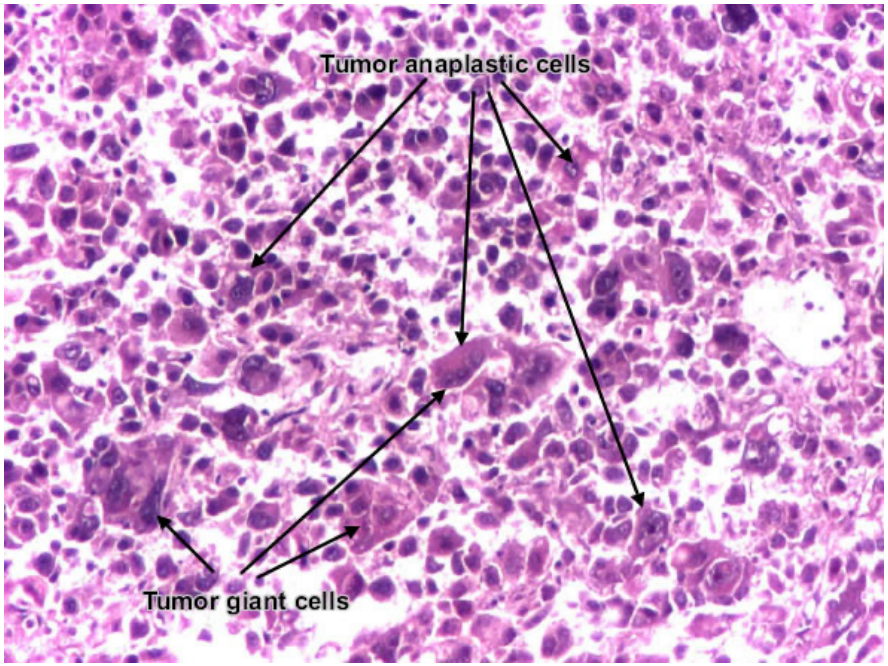
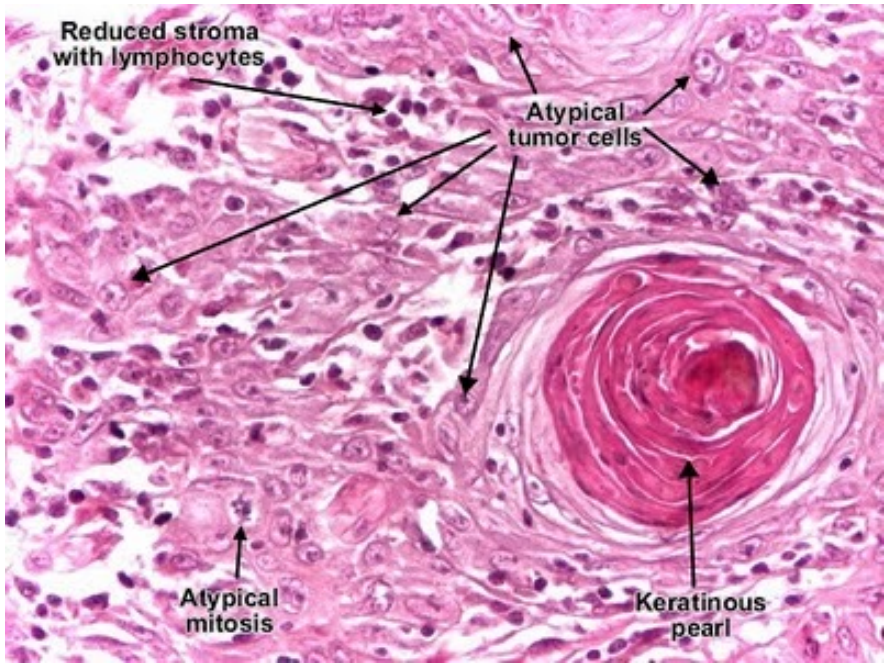
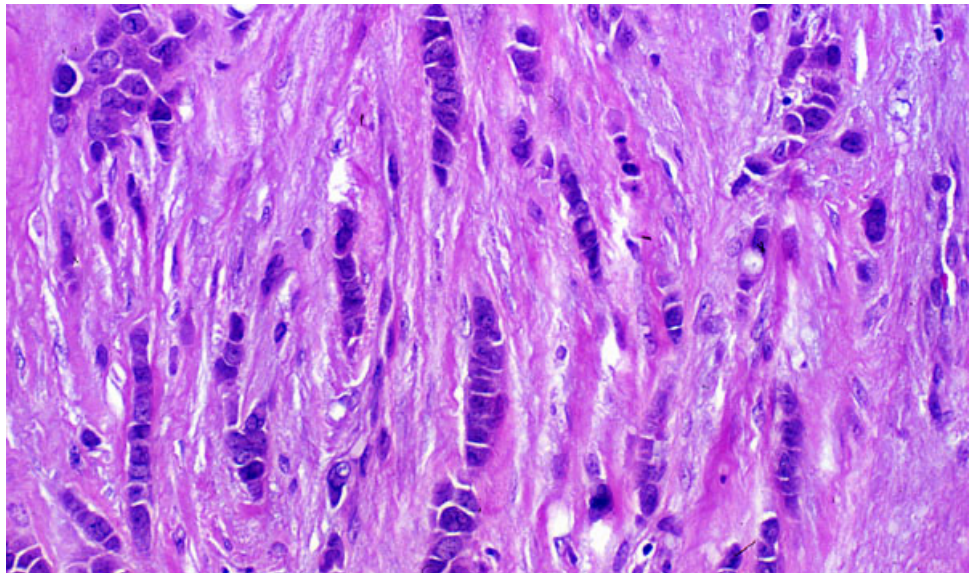
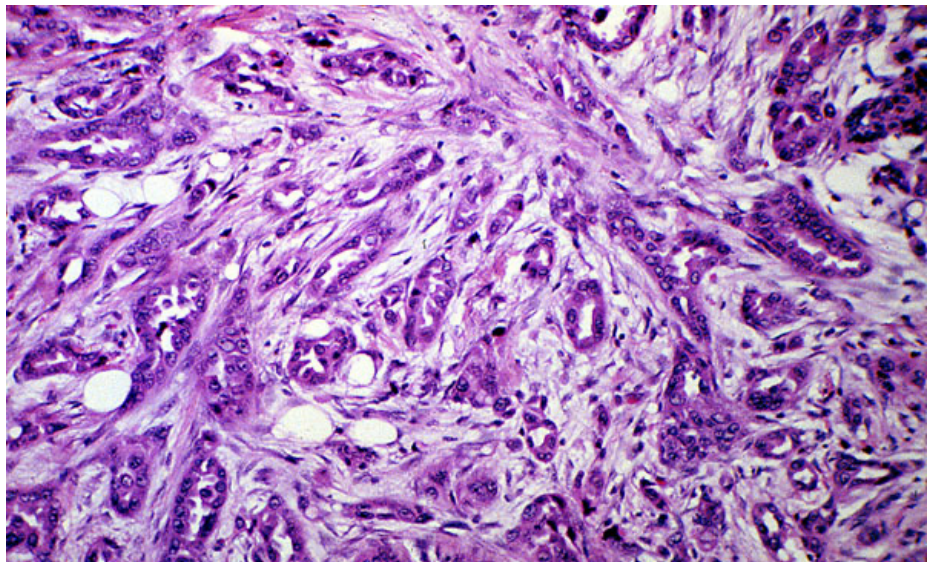


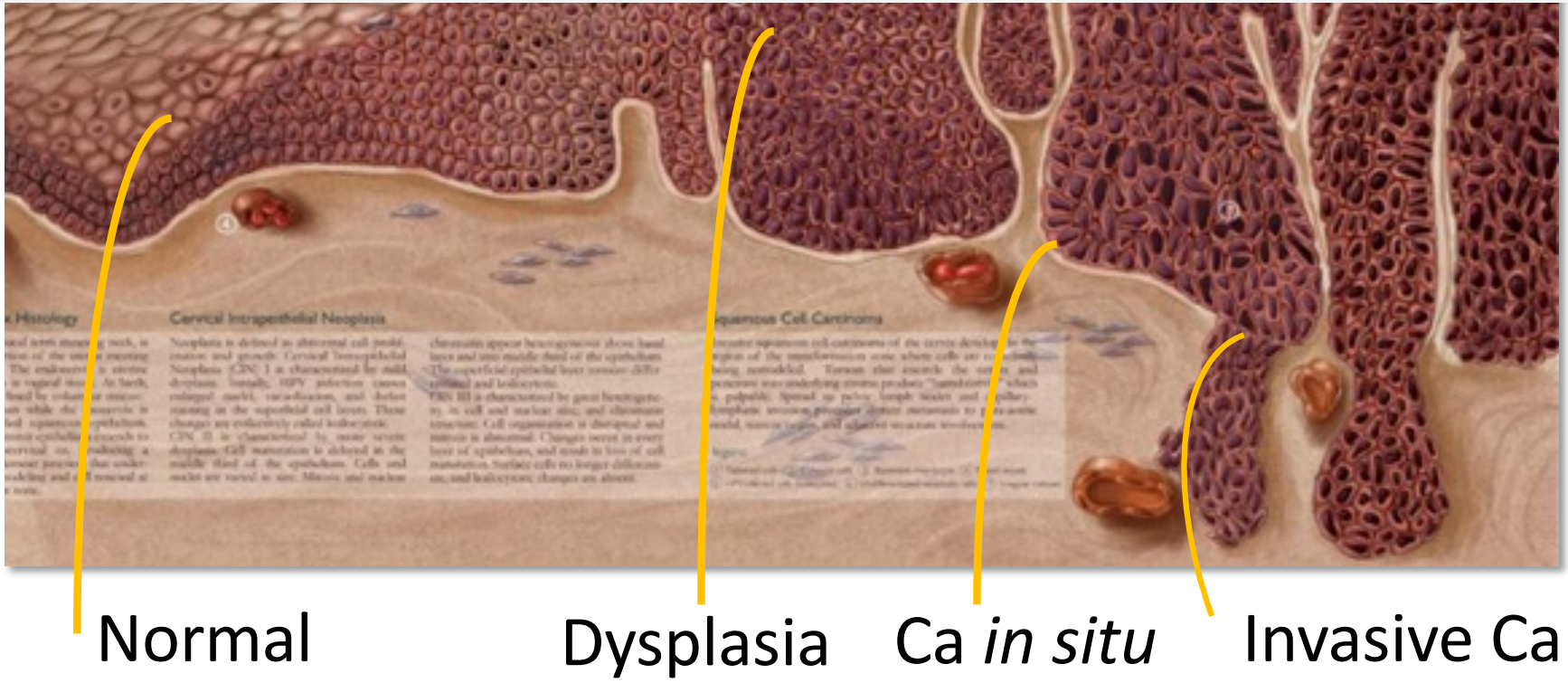
Single strands of malignant cells



The malignant cells are arrange in trabecular and solid patterns, with gland formation.

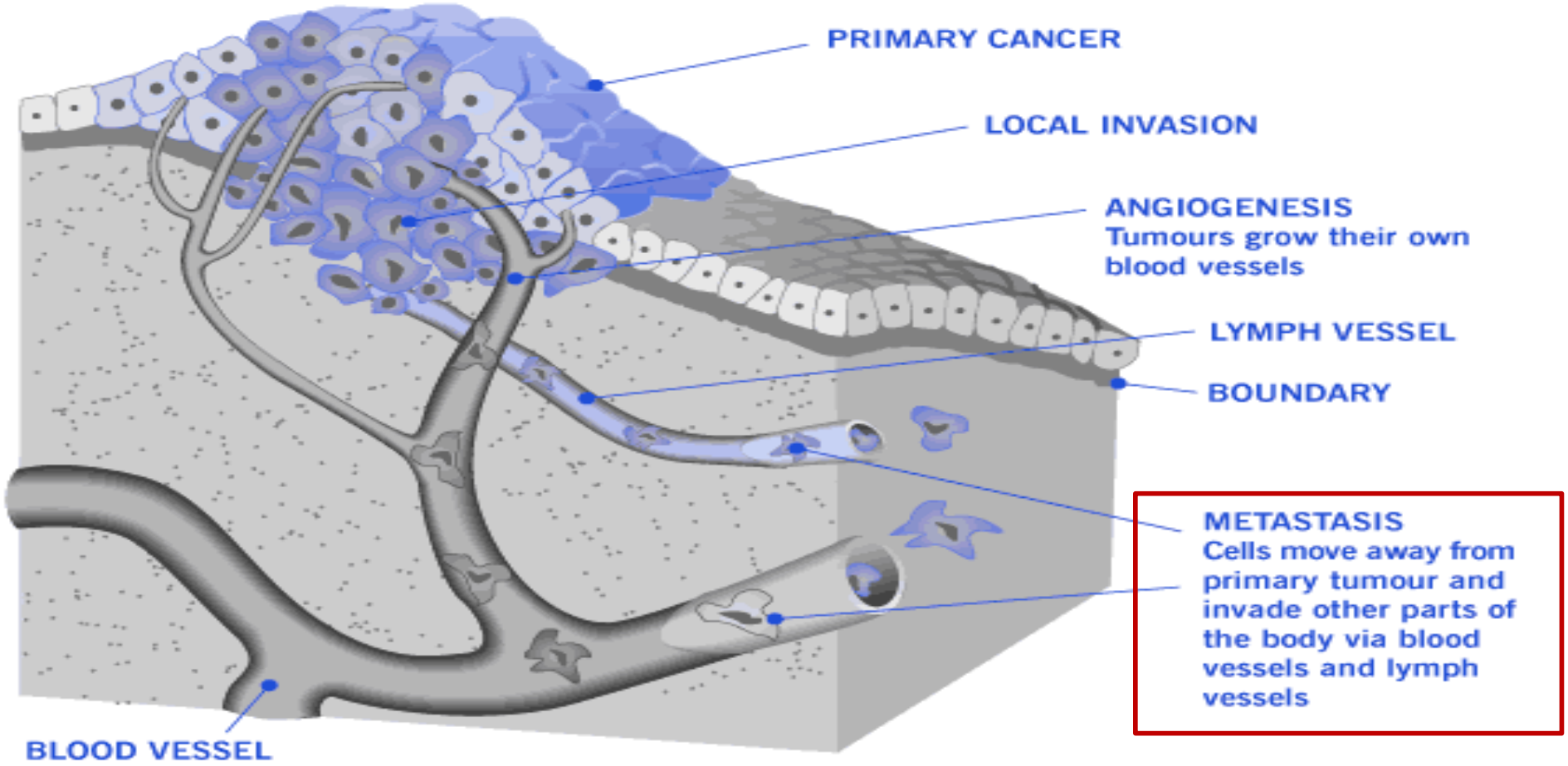
- Malignant neoplasms are called cancers. They included :
- Carcinoma *in situ ( cancer at the site)*. They do not invade and destroy basement membrane but, given enough time, will transform into invasive cancer.
- Invasive cancers ;

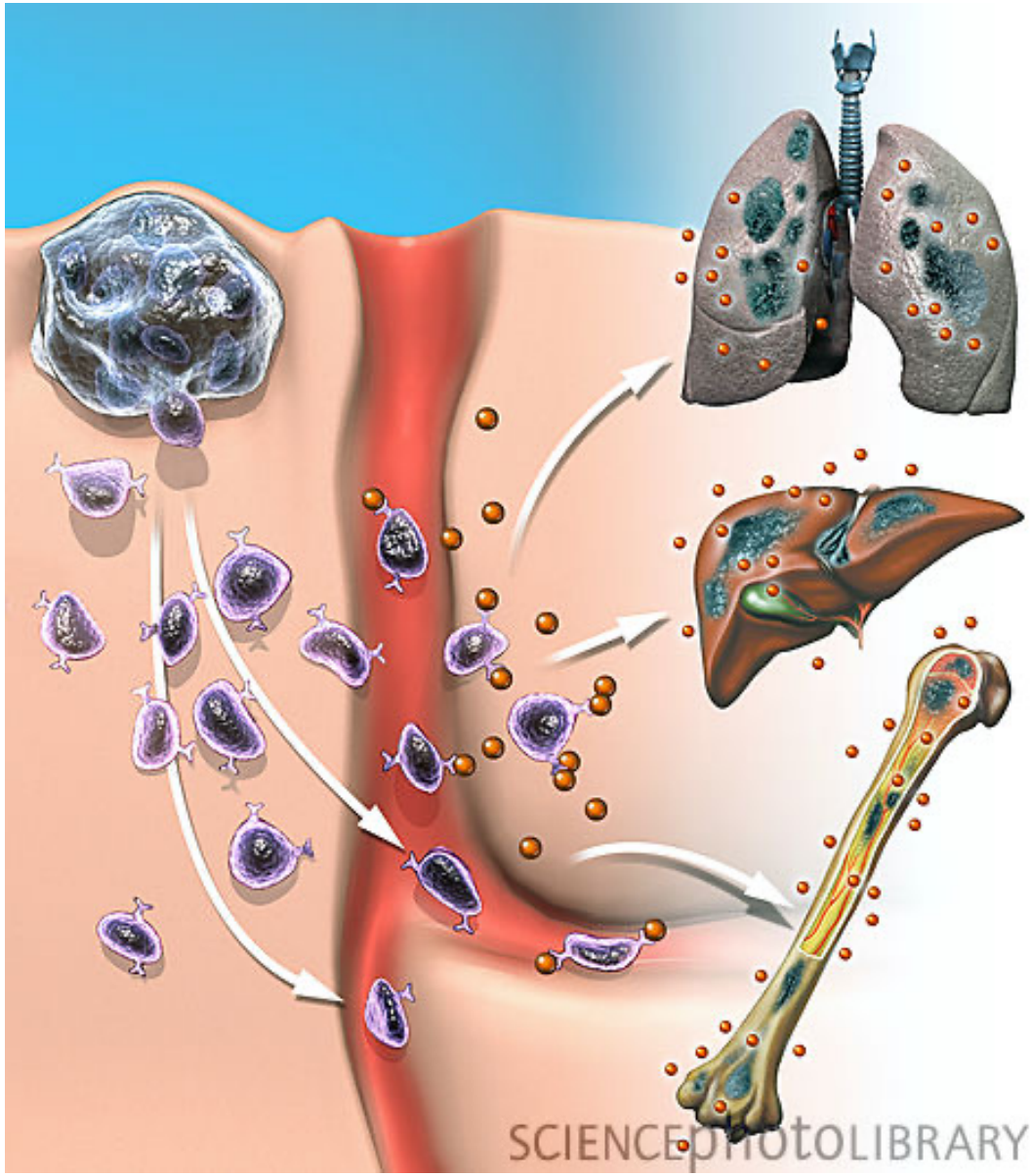
  they invade and destroy the surrounding tissue, may form *metastases* and eventually kill the host.



# Metastasis

Cancer cells can <u>invade and destroy healthy tissues</u>, and they <u>can spread</u> *( metastasis )* through the bloodstream and the lymphatic system to other parts of the body.






- Primary and secondary cancers. Artwork showing the spread of cancer from a primary site in the skin (upper left), through the blood stream (centre), to form secondary cancers elsewhere in the body (right). The secondary locations shown here are the lungs, liver and a skeletal long bone. The body will produce white blood cells (orange spheres) to attack the cancer cells (purple), but once the cancer has spread (a process called metastasis), the prognosis is poor. Secondary and primary cancers can be treated by surgery and/or radiotherapy and chemotherapy, depending on the location of the tumours.

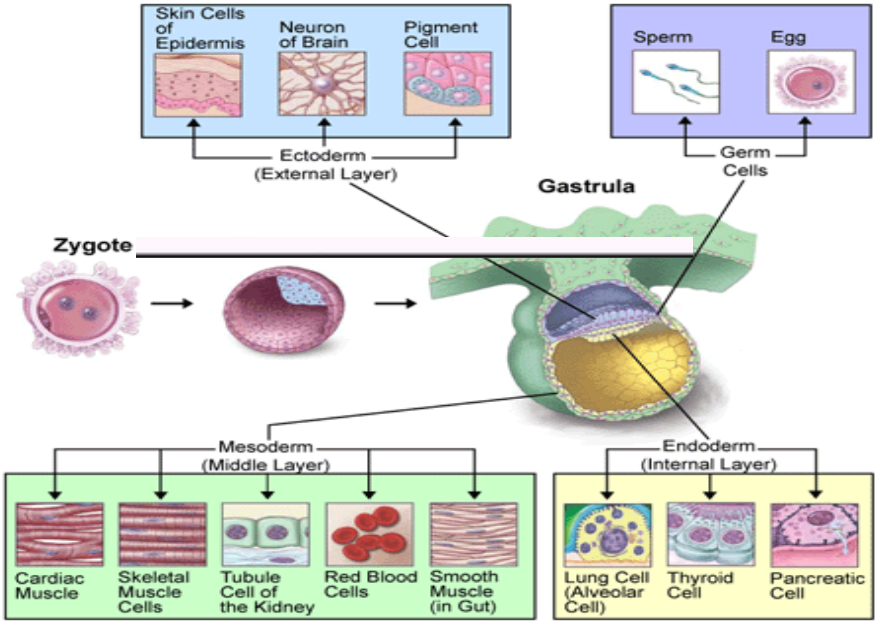
# Laboratory demonstration

- Tumors arising from any germ layer or more than ones.

| Benign Tumors |
| --- |
| Adenoma |
| Papilloma |
| Fibroma |
| Chondroma |
| Rhabdomyoma |
| Leiomyoma |
| Haemangioma |
| - |
| Lipoma |
| Osteoma |

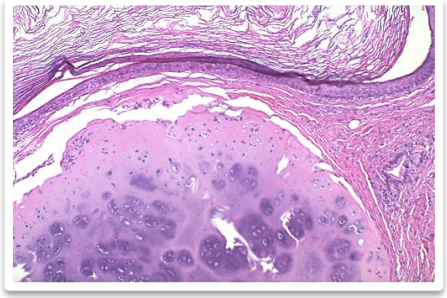
**Exception**

- Hepatoma
- Lymphoma
- Melanoma
- …*blastoma* , retino*blastoma*, neuro*blastoma*




Tumor from 3 germ layers

Teratoma



# Laboratory demonstration

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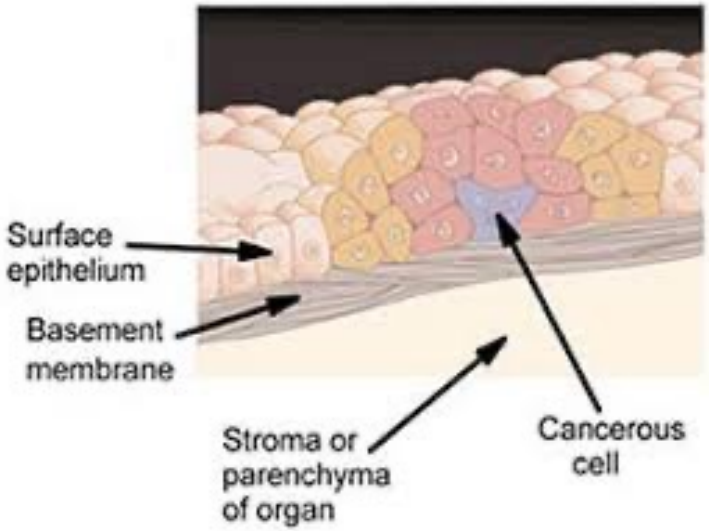
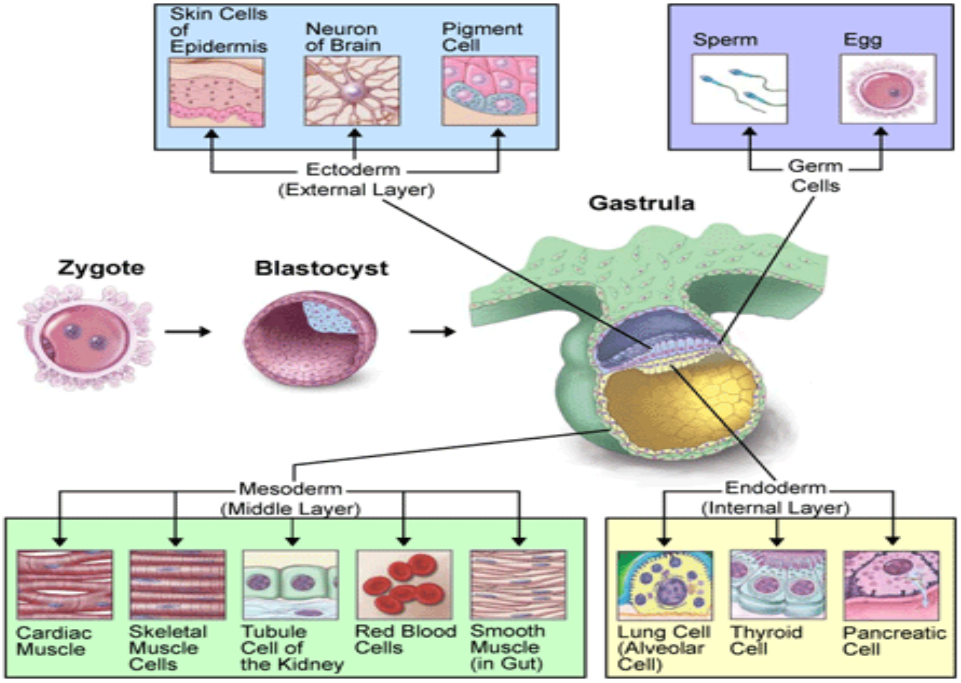
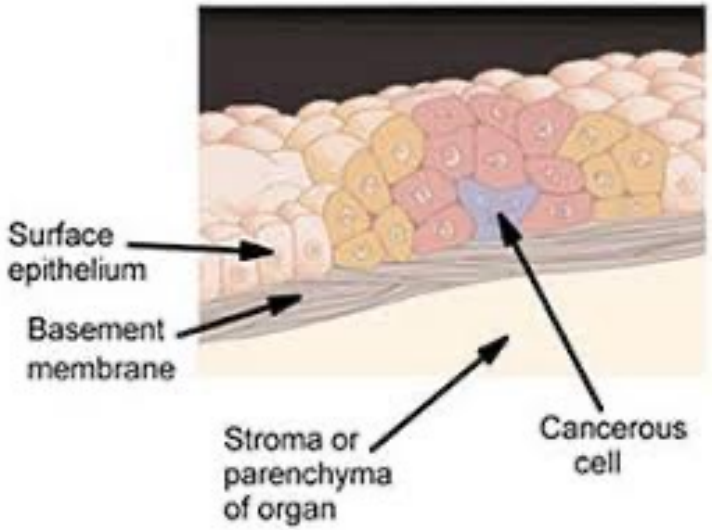



- Malignant tumors:
  - mesenchymal tissue are usually called **sarcoma**
  - Epithelial cell origin are usually called **carcinoma**
  - Name of origin cell + morphologic character + carcinoma/ sarcoma
  - E.g.:
    - Malignant tumor of the stomach is a gastric adenocarcinoma or adenocarcinoma of the stomach.

| Benign Tumors |
| --- |
| Adenoma |
| Papilloma |
| Fibroma |
| Chondroma |
| Rhabdomyoma |
| Leiomyoma |
| Haemangioma |
| - |
| Lipoma |
| Osteoma |
| Hepatoma |

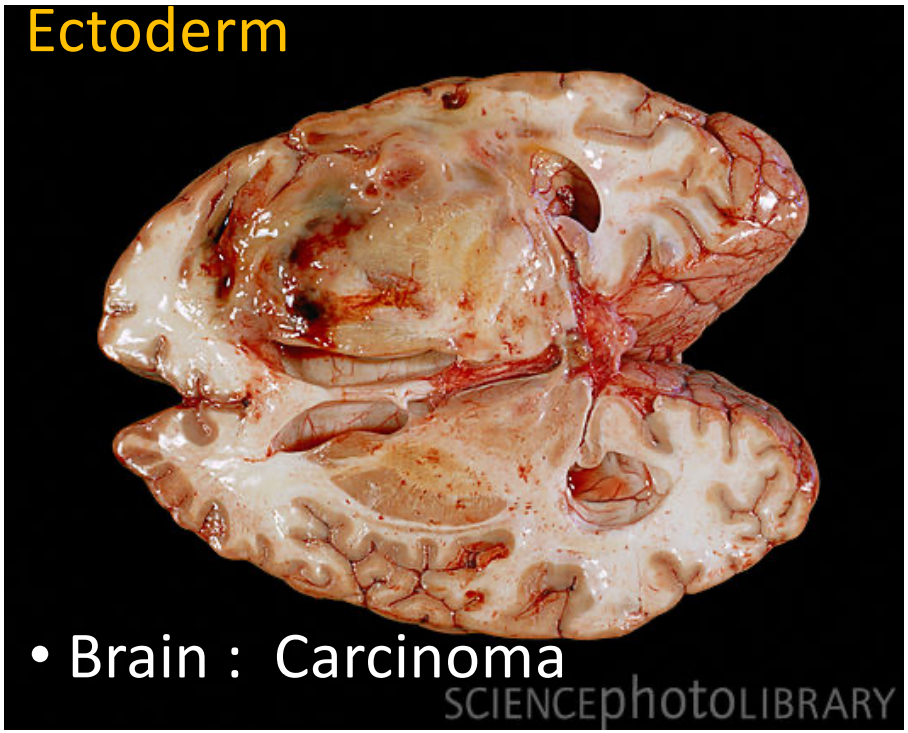



- Malignant tumors:
  - mesenchymal tissue are usually called **sarcoma**
  - Epithelial cell origin are usually called **carcinoma**
  - Name of origin cell + morphologic character + carcinoma/ sarcoma
  - E.g.:
    - Malignant tumor of the stomach is a gastric adenocarcinoma or adenocarcinoma of the stomach.

…9/10 cancer cases are carcinoma, that why we call cancer as “CA”…from the term carcinoma…

Malignant tumor of surface epithelium is called ‘carcinoma’.

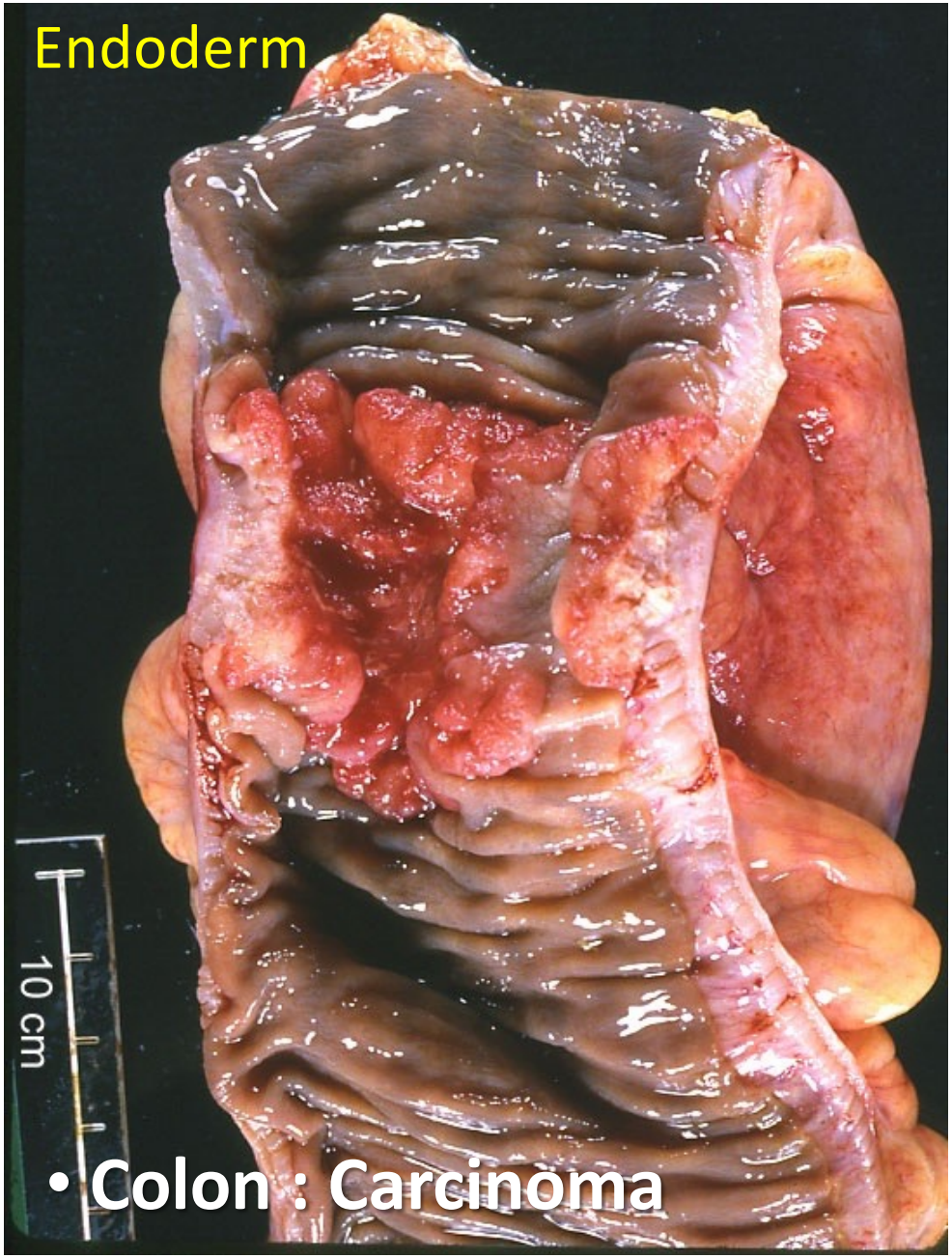

• Lung : Bronchogenic carcinoma





• Skin, Squamous cell carcinoma

- Malignant tumor of connective tissue is called ‘sarcoma’.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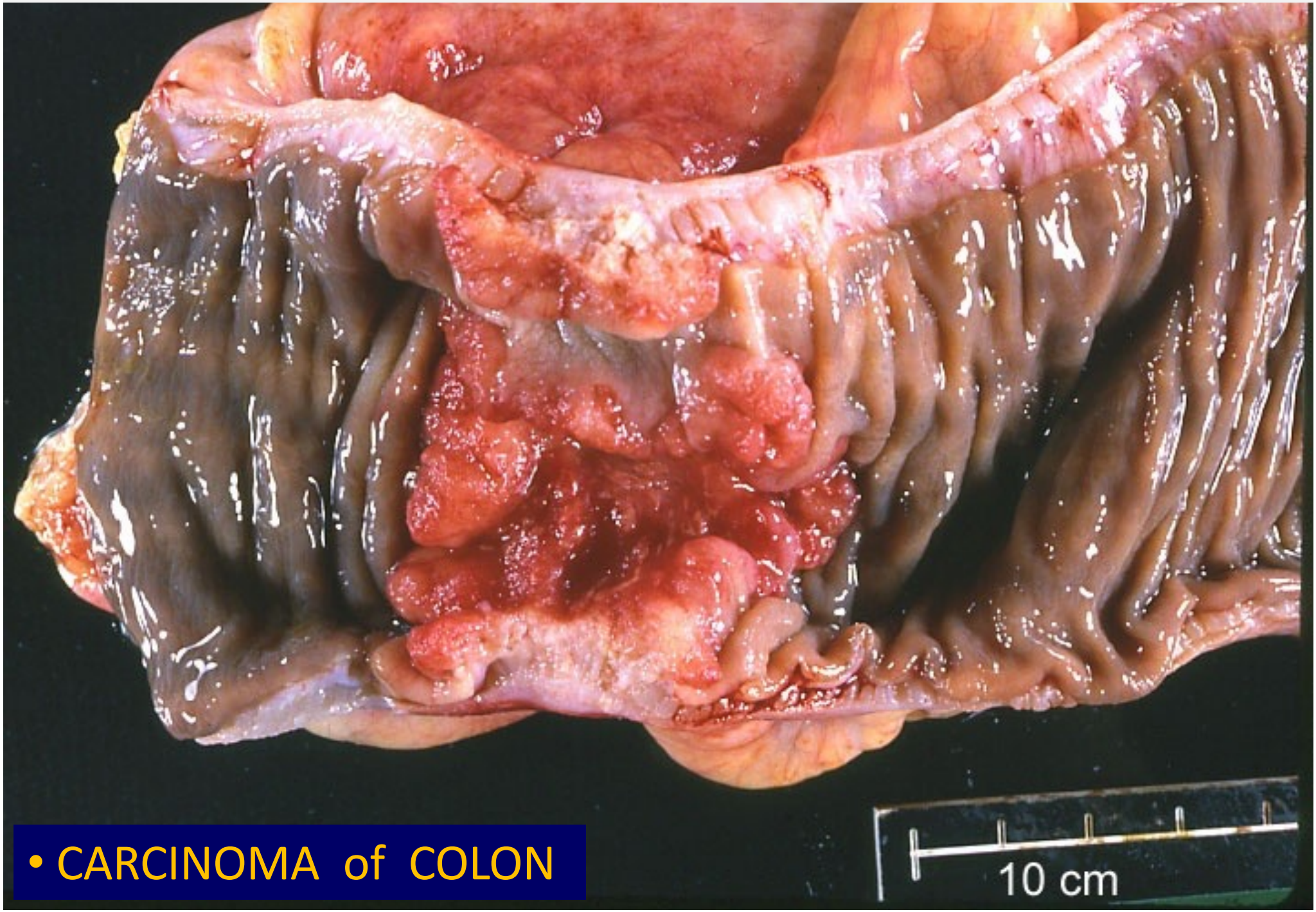

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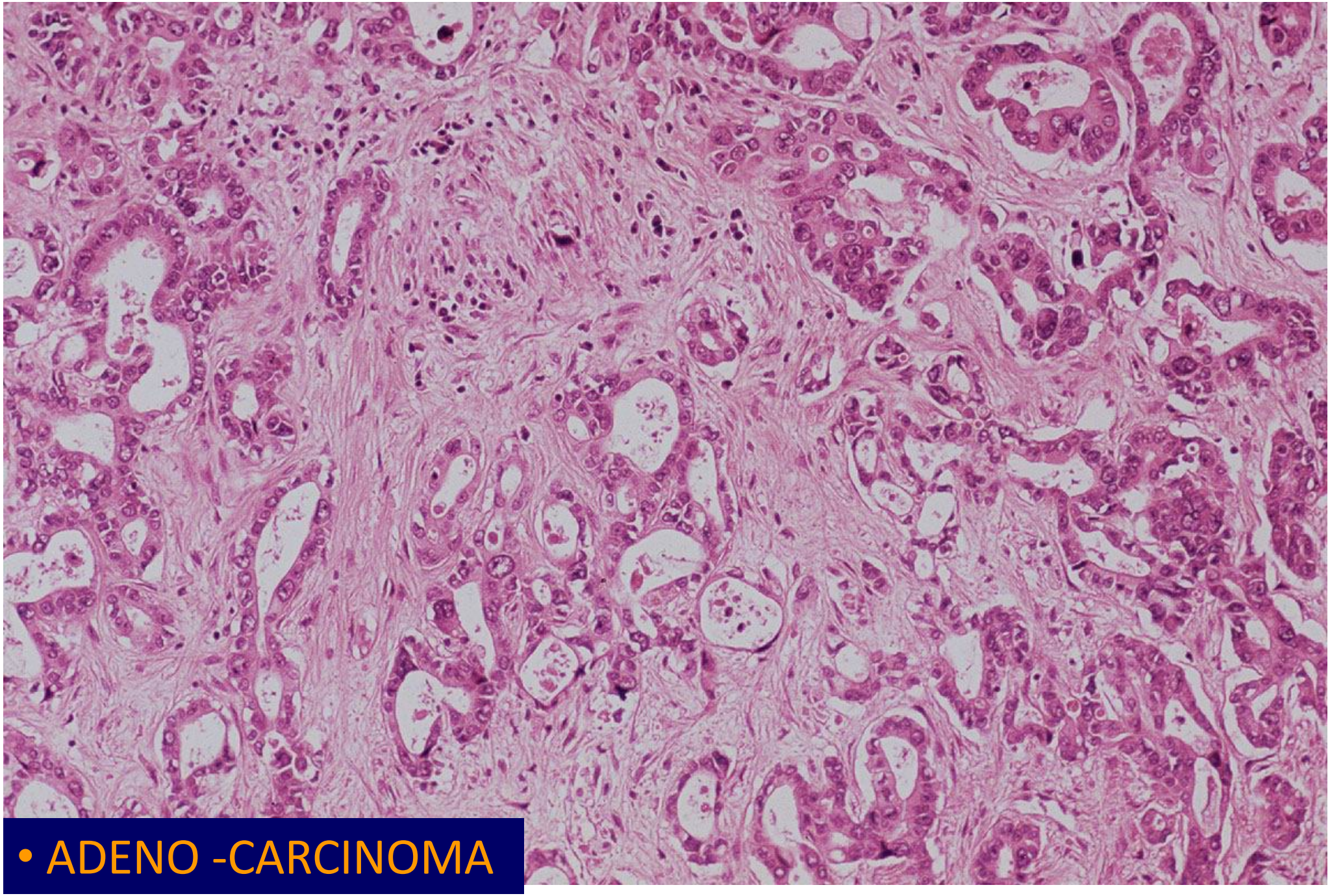

- ADENO -CARCINOMA

- Malignant tumor of connective tissue is called ‘sarcoma’.

- SARCOMA of MUSCLE / Rhabdomyo-sarcoma

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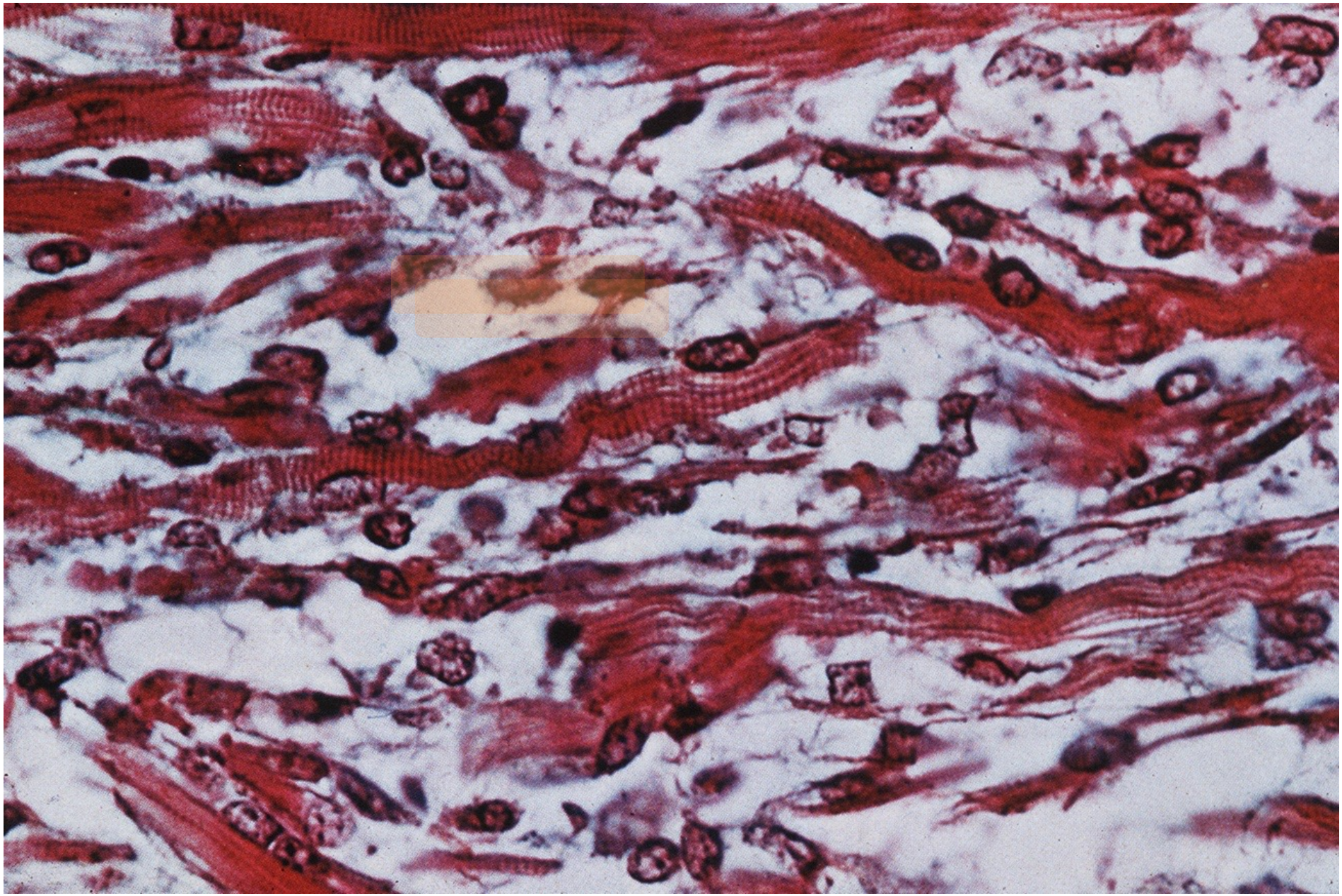
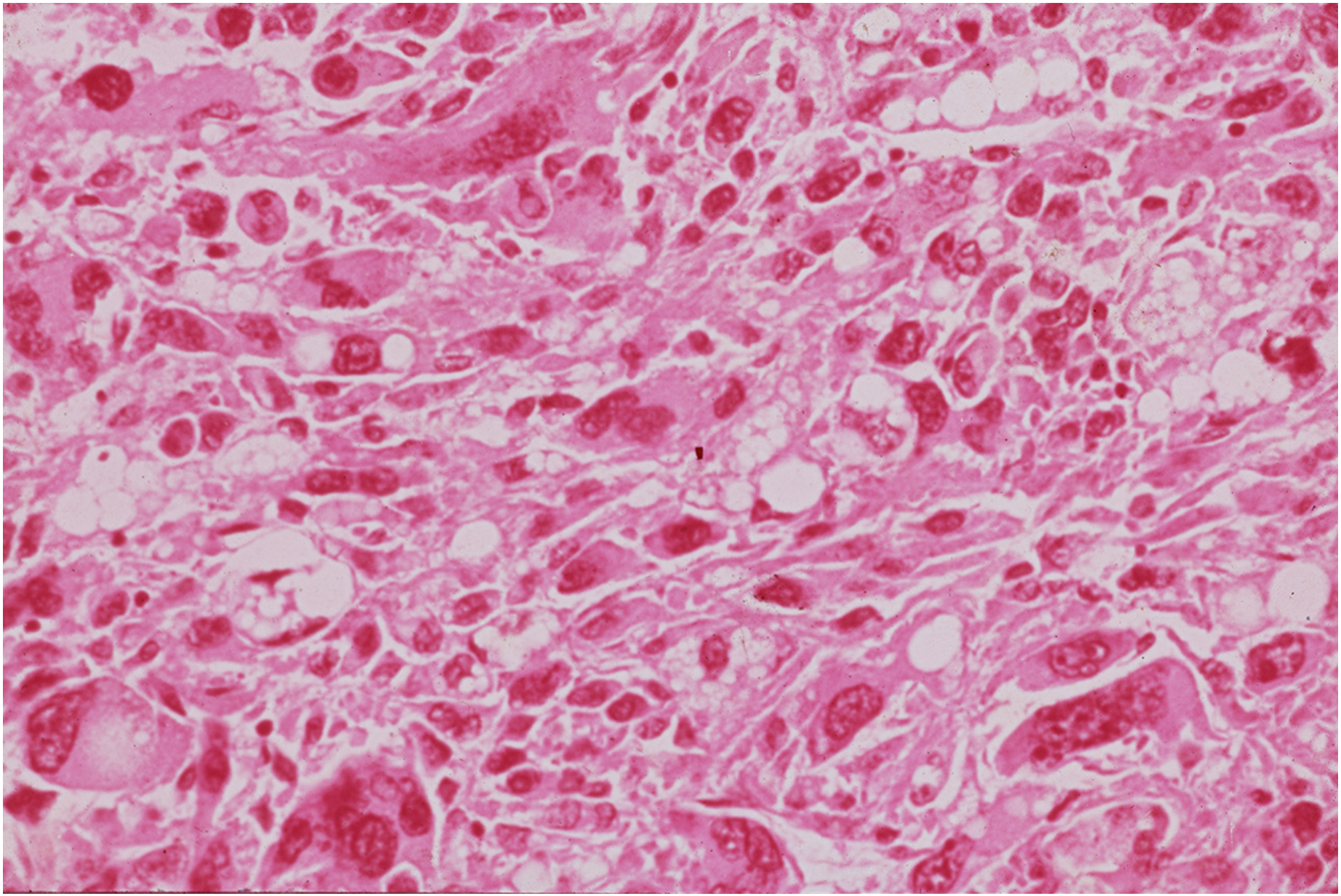


•SARCOMA of MUSCLE / Rhabdo-myo-sarcoma

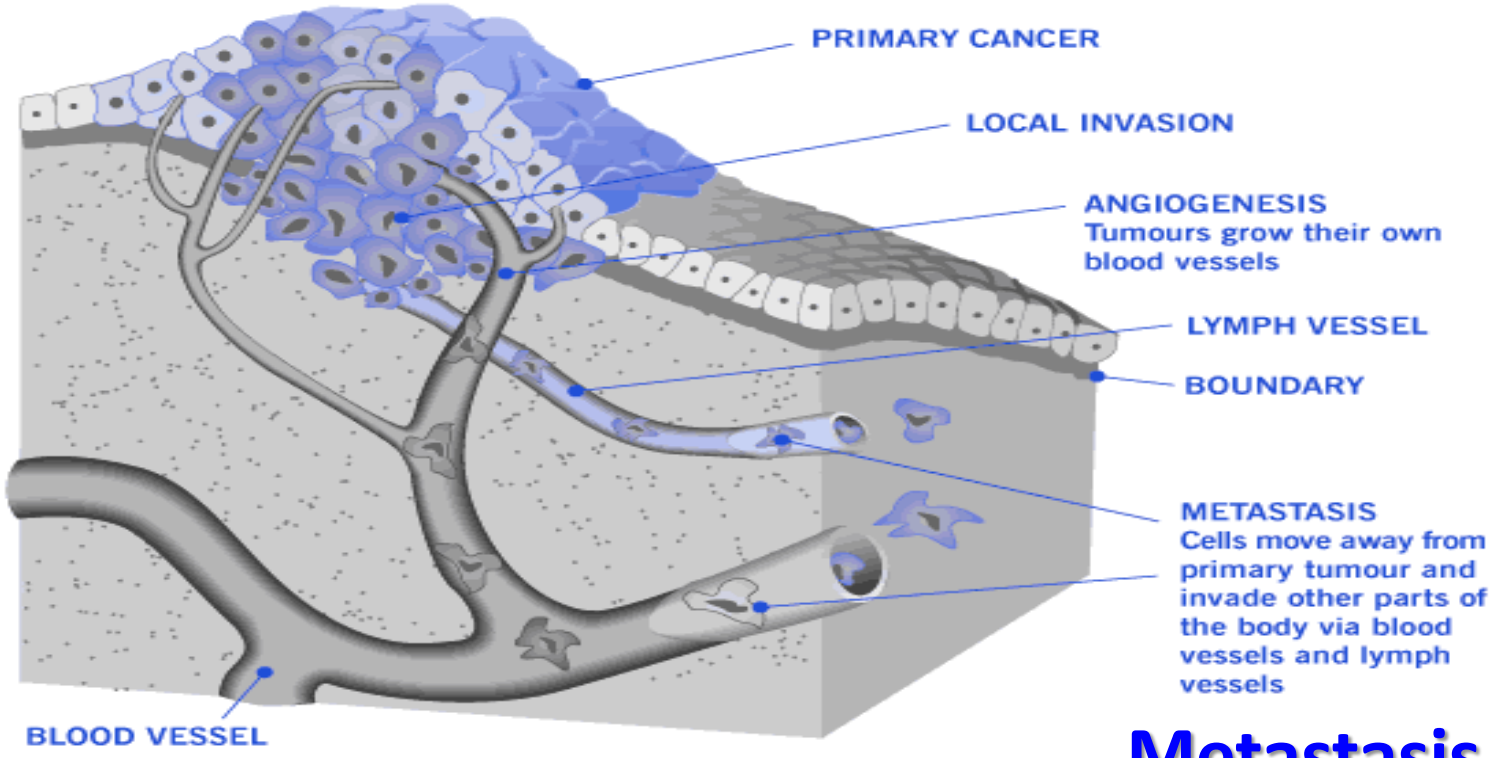
- Malignant tumor of connective tissue is called ‘sarcoma’.



•SARCOMA of FAT tissue / Lipo-sarcoma

**Cancer :** A general name for more than 200 diseases in which abnormal cells grow out of control.

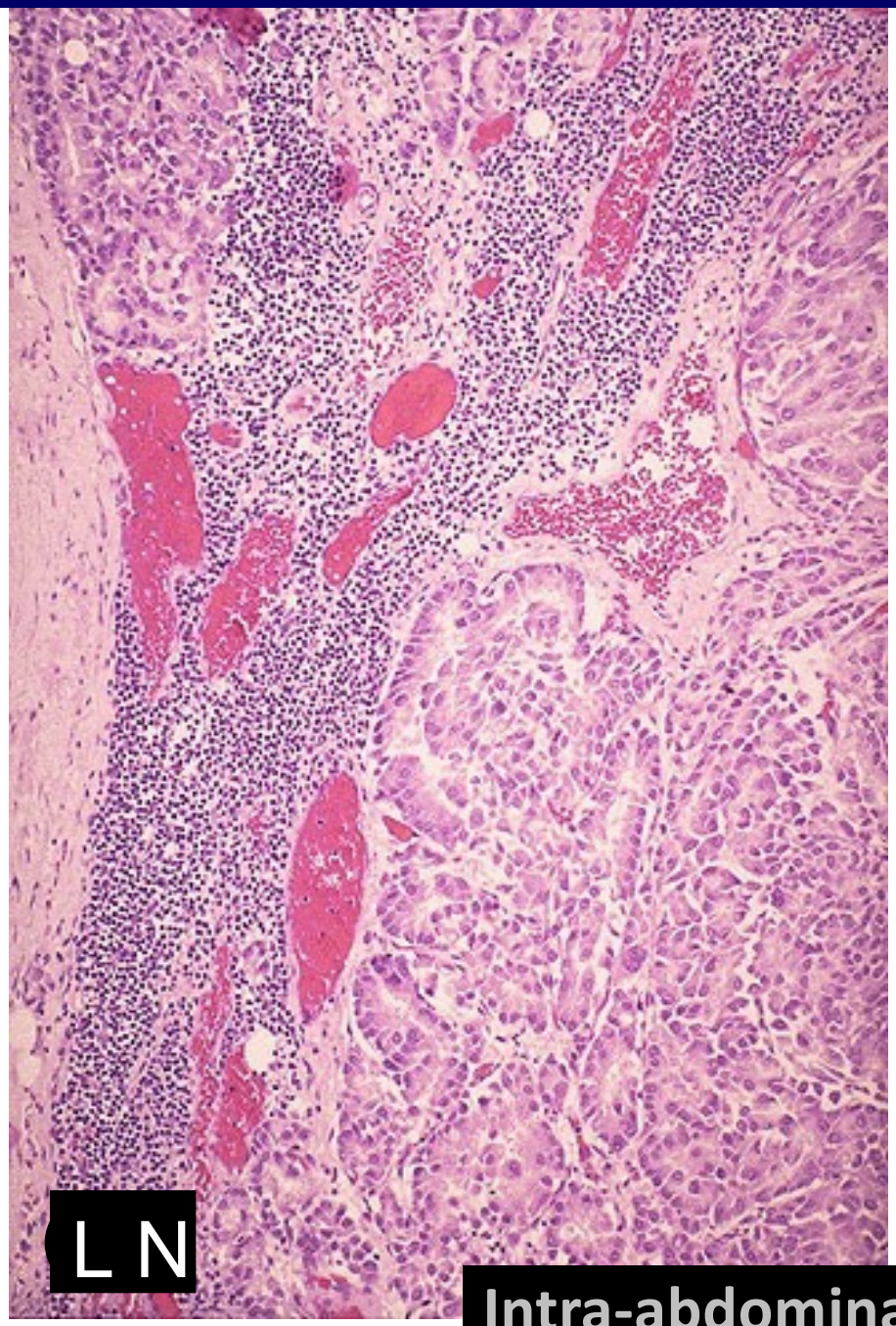
Cancer cells can <u>invade and destroy healthy tissues</u>, and they <u>can spread</u> *( metastasis )* through the bloodstream and the lymphatic system to other parts of the body.

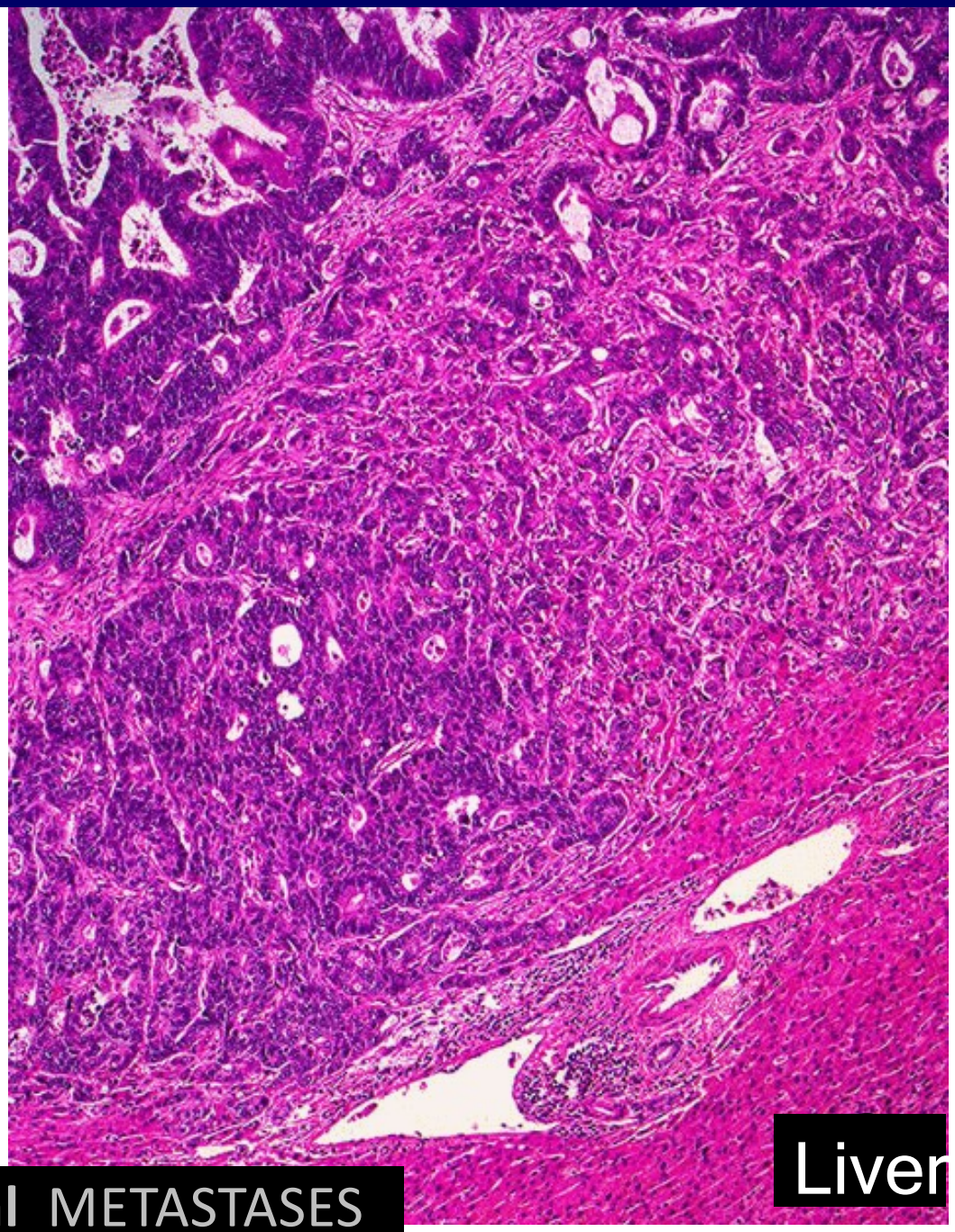



**Metastasis**

- Most carcinoma METASTASIS *via* lymphatic and later on vascular routes.

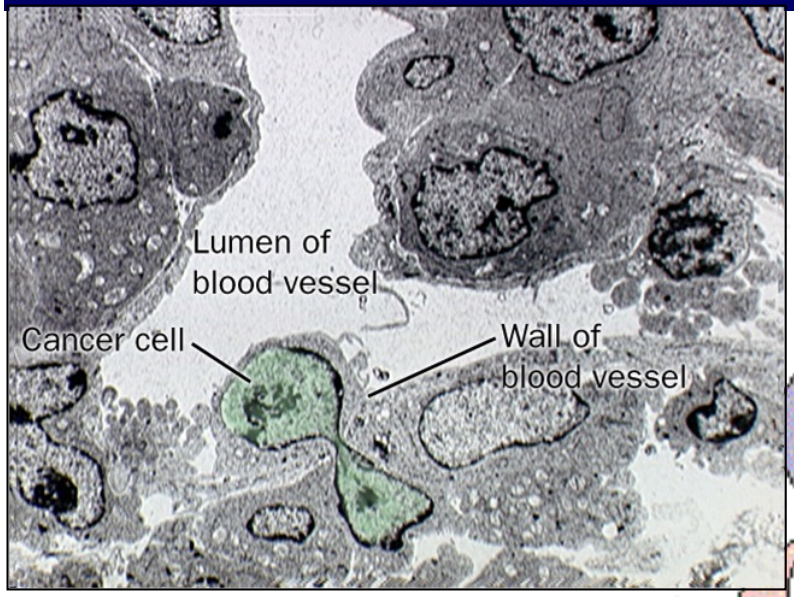
- **METASTASIS intra-abdominal tumor : LN / Liver**

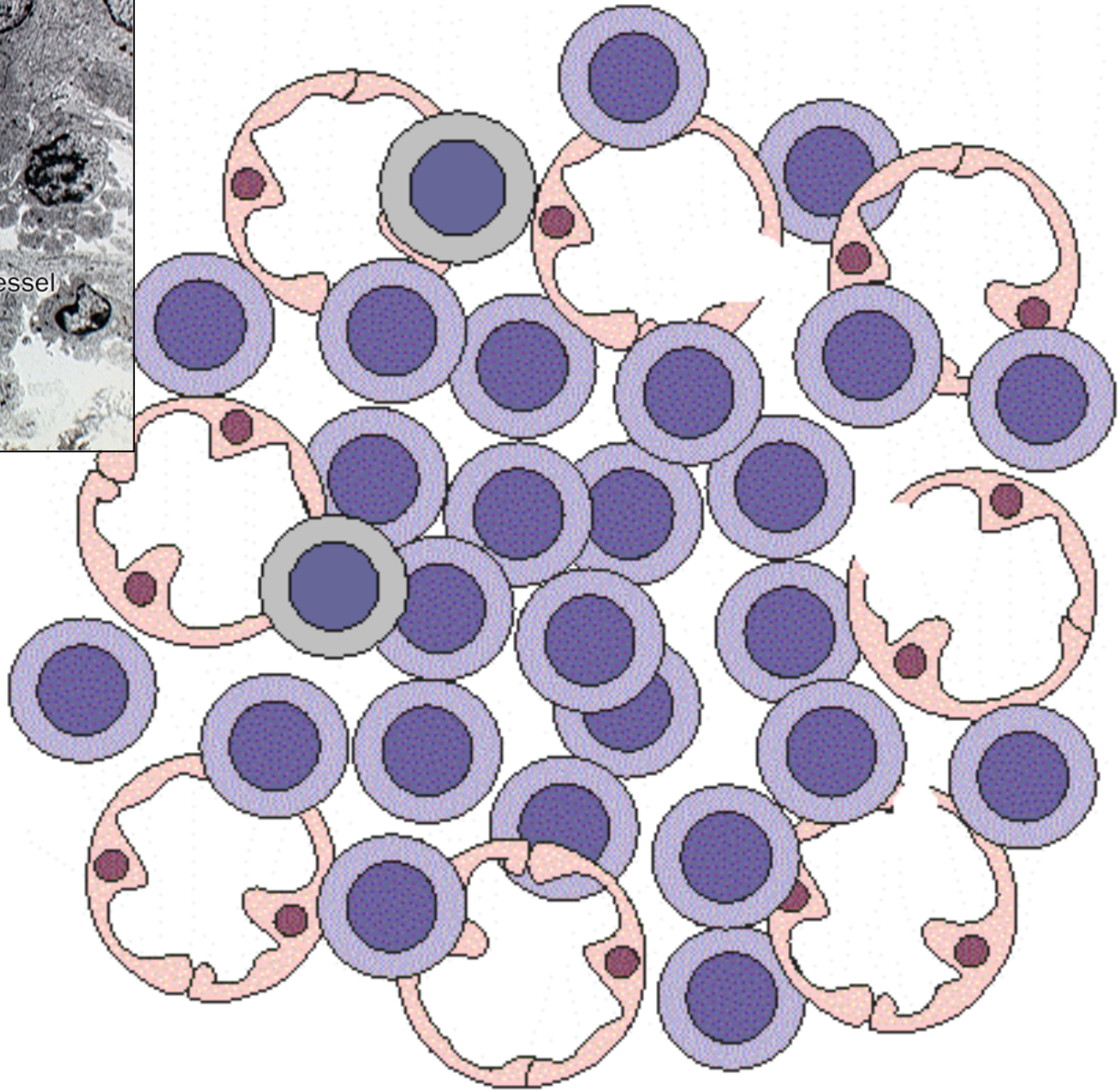


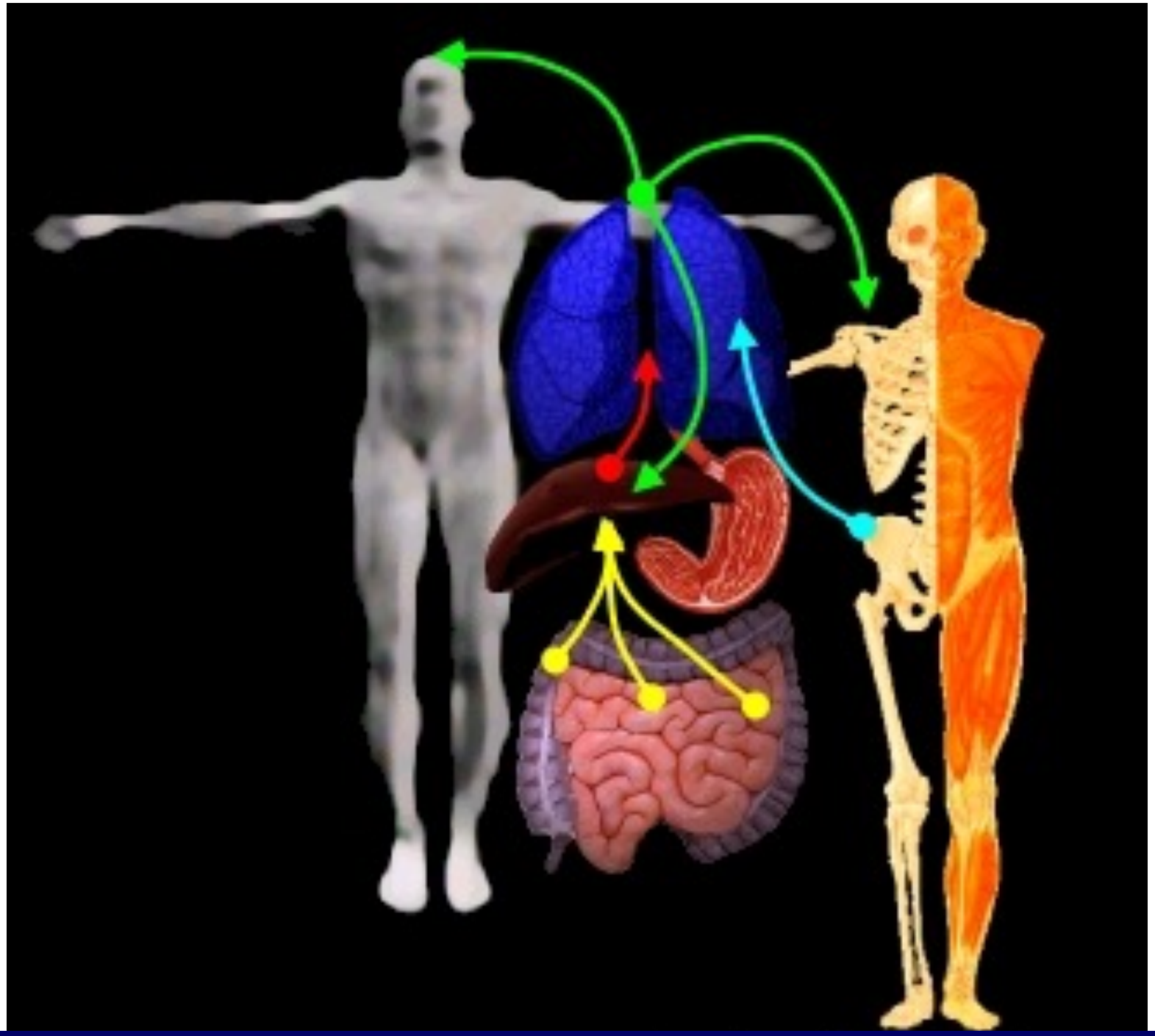




**Intra-abdominal** METASTASES

# •Sarcoma metastasis : using  vascular as a major route





**The most common METASTASIS sites : Lungs / Liver**

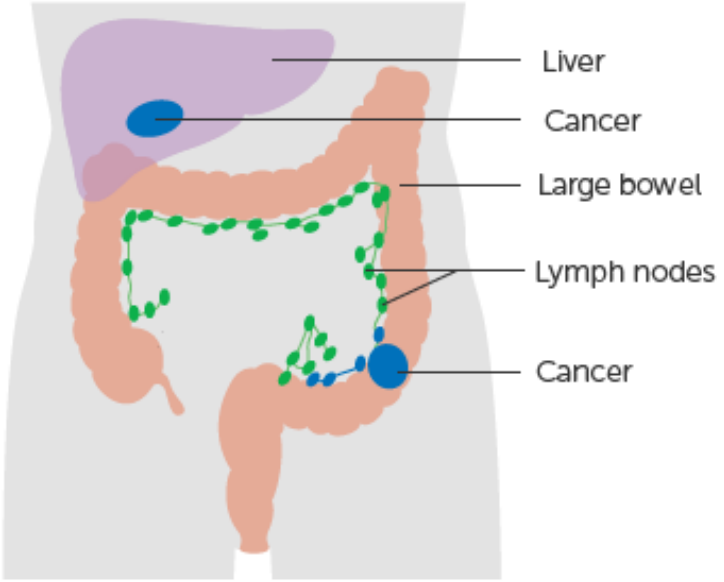
# The most common METASTASIS sites : Lungs / Liver

**TNM Staging :** System of cancer: A system to describe the amount and spread of **cancer** in a patient's body.

**T** describes the size of the **tumor** and any spread of **cancer** into nearby tissue;

**N** describes spread of **cancer** to nearby lymph nodes; and

**M** describes metastasis (spread of **cancer** to other parts of the body).




| Stage | | | Pathological description | 5-year survival |
|---|---|---|---|---|
| Dukes | TNM | Numer-ical | | |
| A | T1NoMo | I | Ca limited to the mucosa and sub-mucosa | >90% |
| B1 | T2NoMo | I | Ca extending to the muscularis | 85% |
| B2 | T3NoMo | II | Ca extending to serosa and be-yond serosa | 70-80% |
| C | TxN1Mo | III | Ca affects to regional lymph nodes | 35-65% |
| D | TxNxM1 | IV | Distant metasta-ses (liver, lungs ...) | 5% |

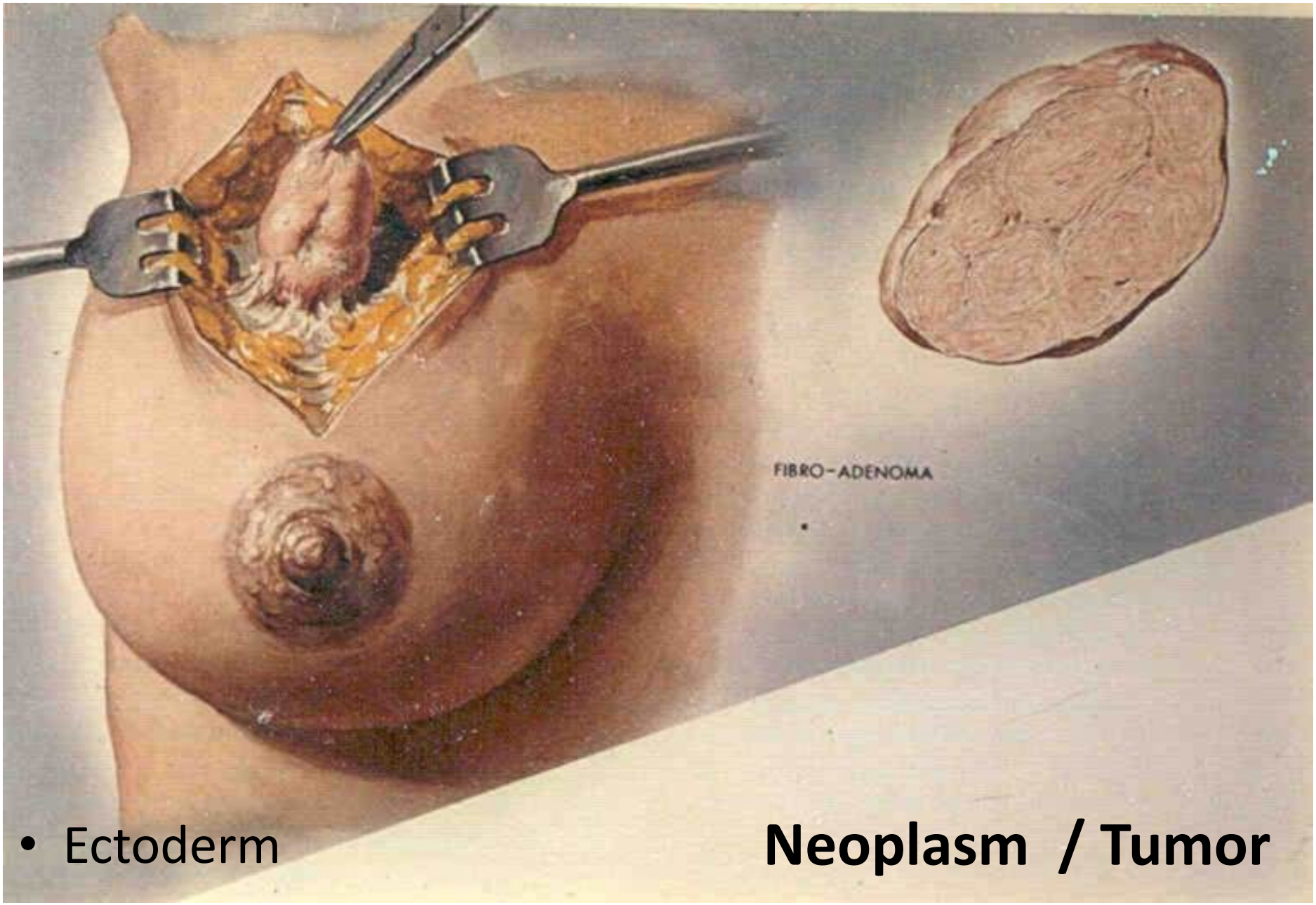
staging and prognosis of colorectal cancer

- Benign tumors, named ending up with – OMA, with exception these tumors are marlignant :

- Hepatoma – primary tumor of liver parenchyma
- Lymphoma - primary tumor of lymph node
- Melanoma - tumor of melanocyte
- Seminoma - tumor arising from seminiferous tubule

- However in tumors, with their names ending up with – BLASTOMA, they are embryonal cell tumors, and all are malignant tumors, e.g.
- Neuro-blastoma,
- Retino-blastoma and
- Medalo-blastoma.

- PROBLEMS WITH BENIGN TUMORS



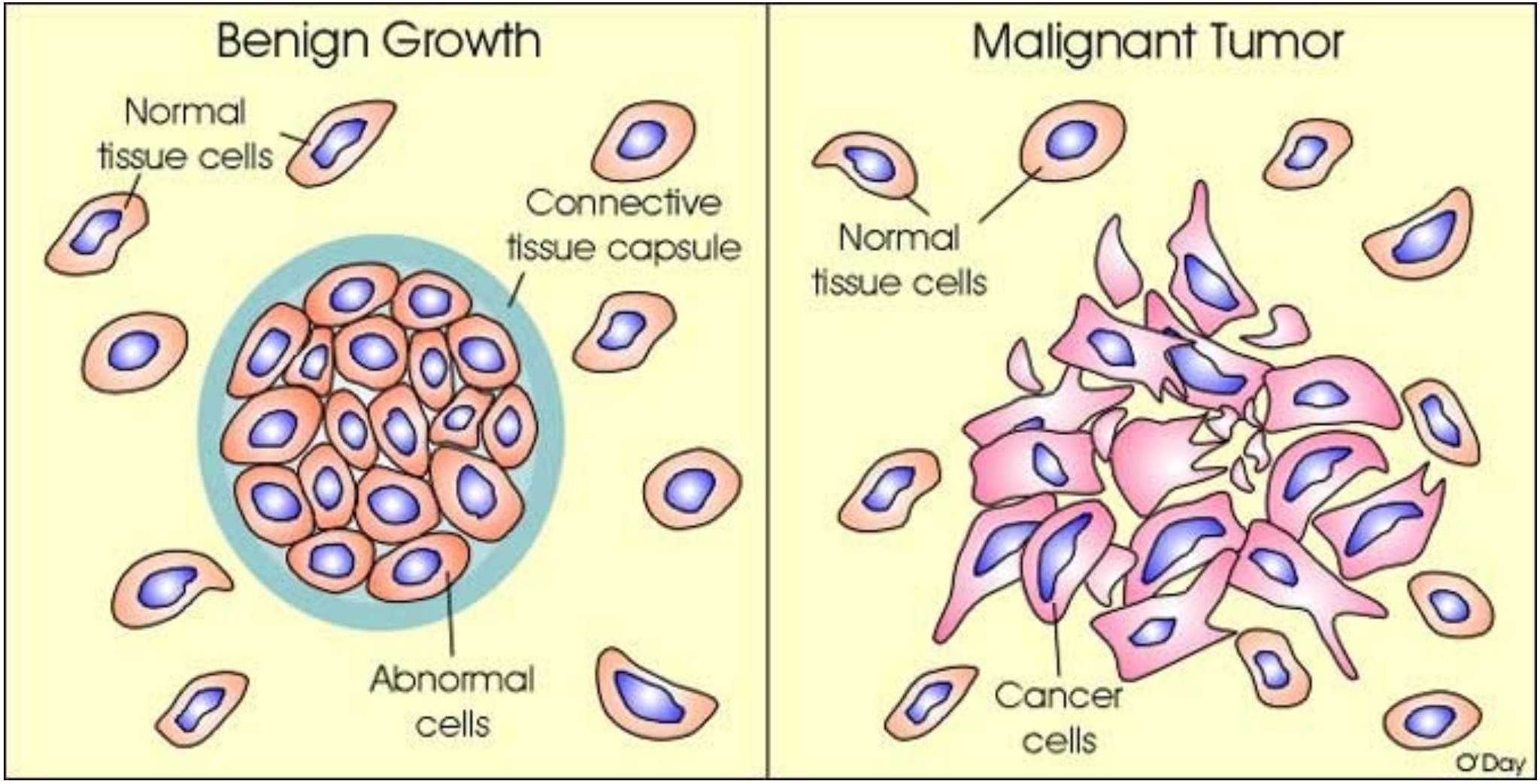

- Ectoderm

**Neoplasm / Tumor**

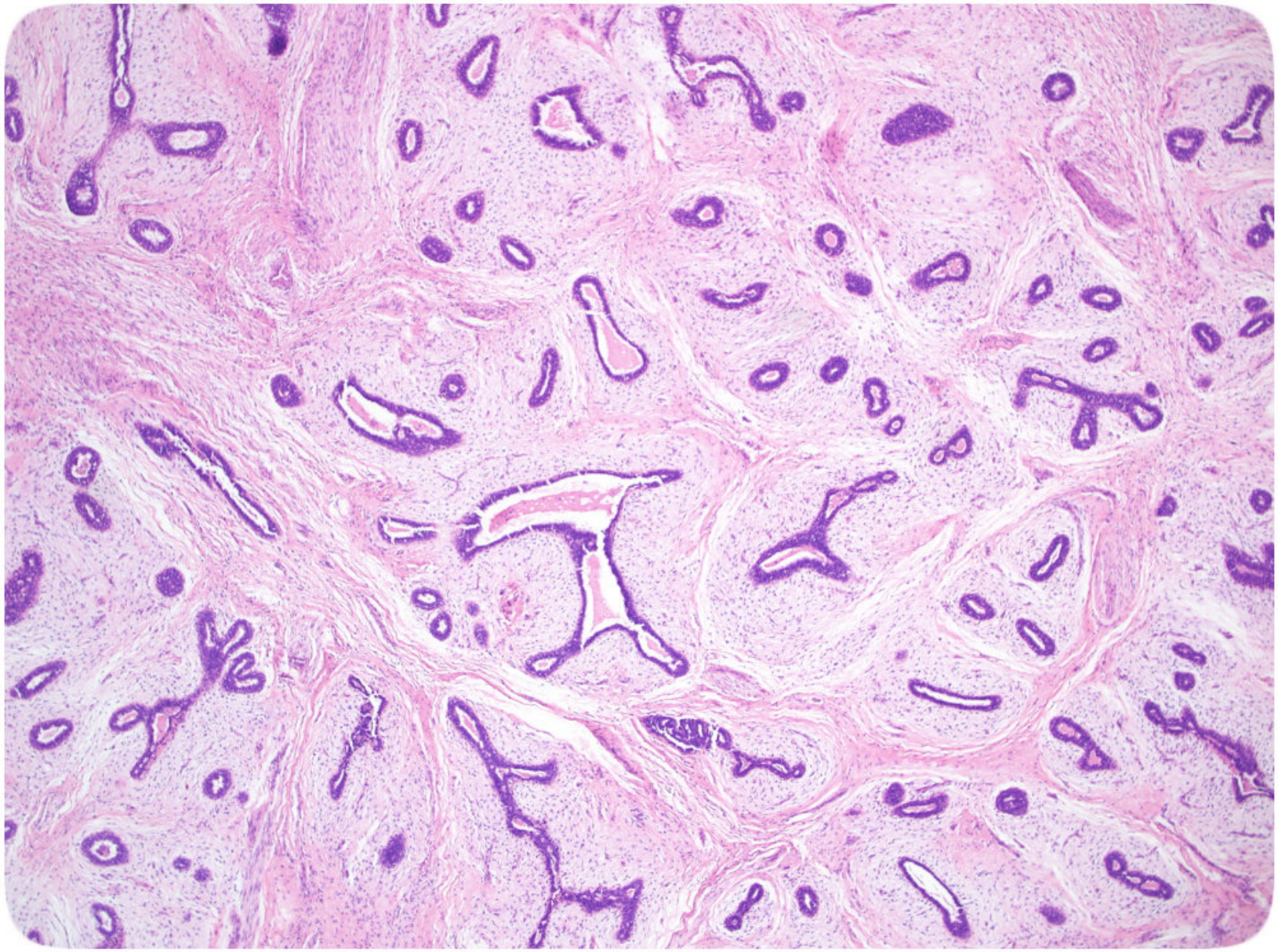
Common presentation of tumor : ***a painless mass***

Distinct tumor border with pseudo –capsule in a benign breast tumor : *Fibroaden-oma*

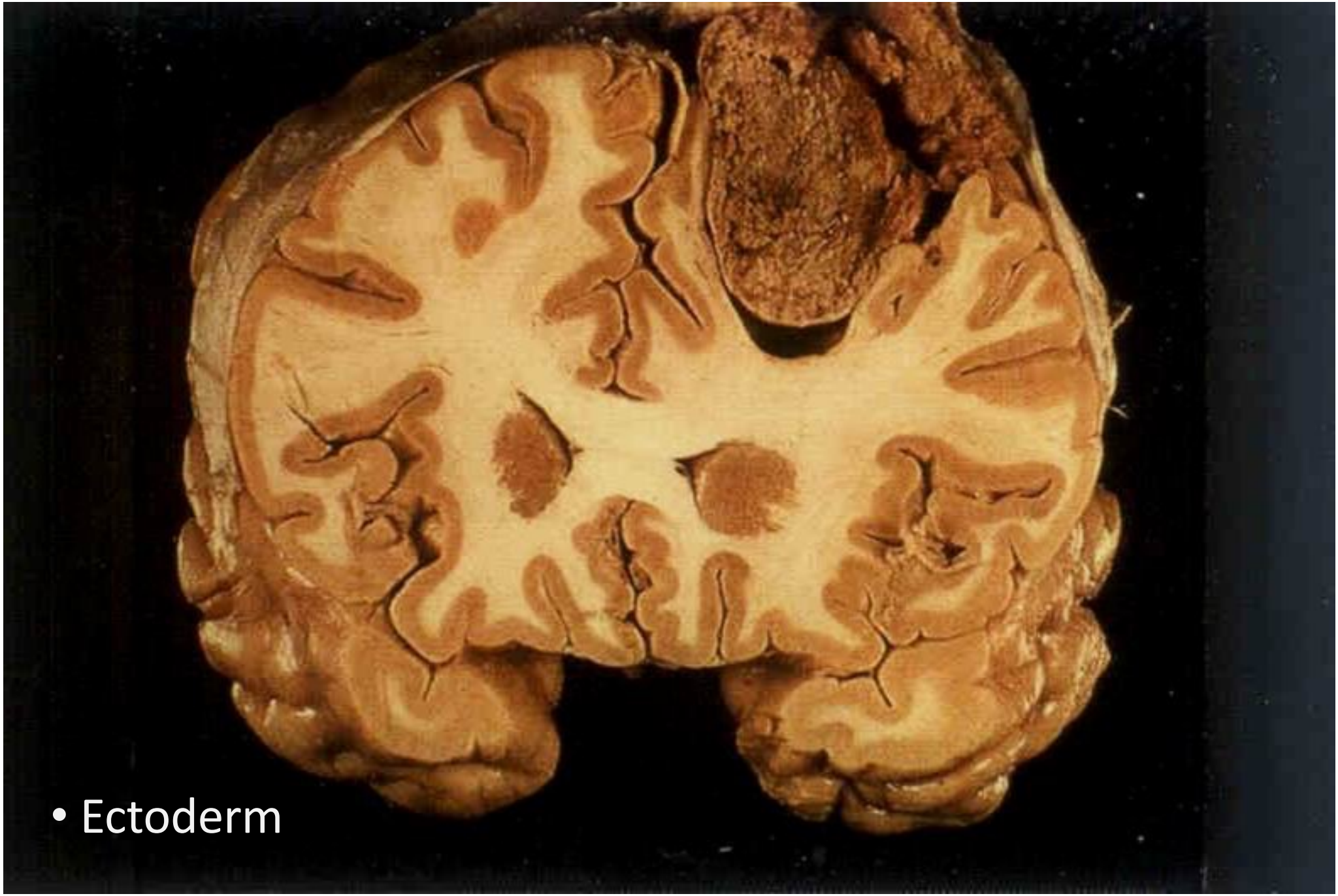
# Different growth patterns in *benign* and *malignant* tumors



•Tumor composes of mamary ducts and fibrous tissue proliferation.



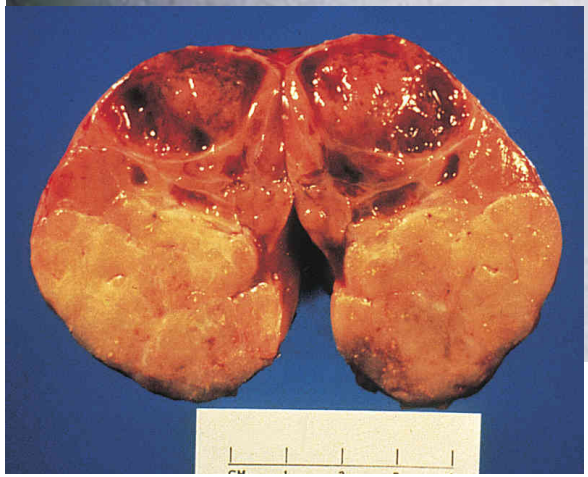
- Benign tumor of meninges : *Meningi-oma*

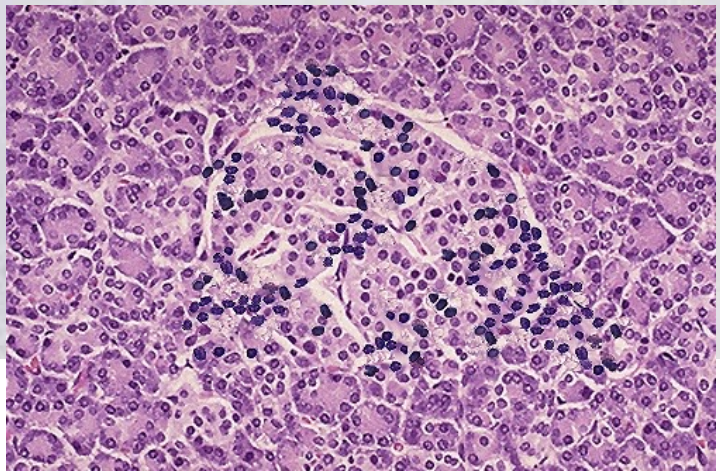


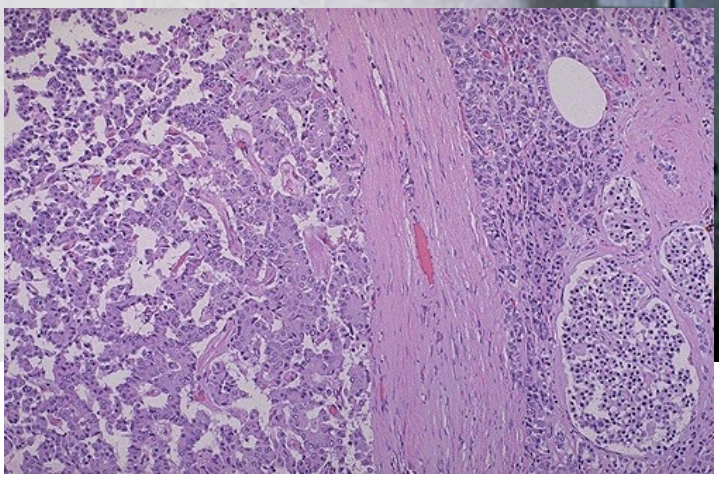
- Ectoderm

# Pancreatic endocrine tumor : *Insulin-oma*

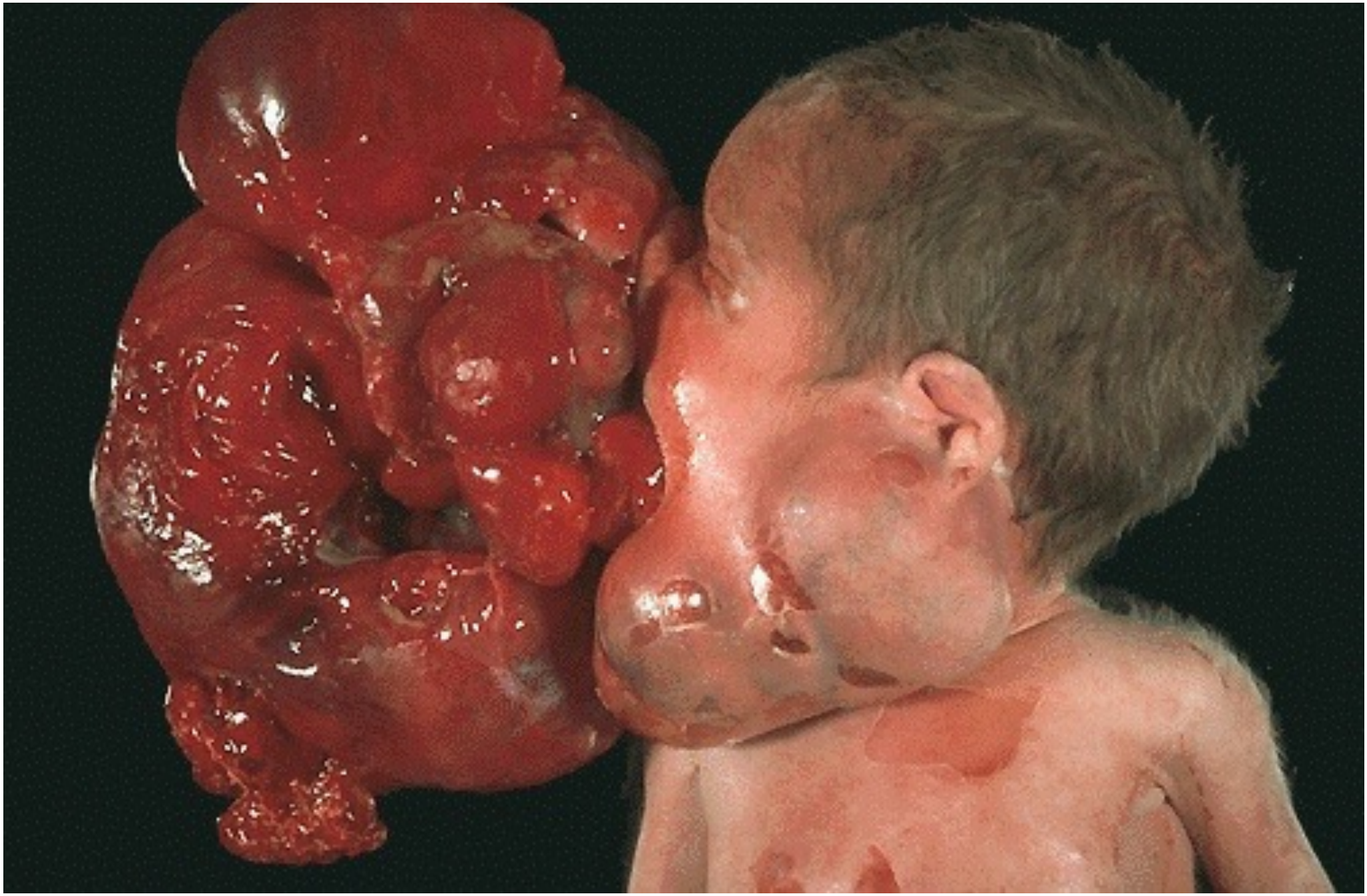
- Endoderm







- Is it tumor or what ! ? *Is it benign or malignant ?*



# Teratoma : tumor originates from more than one germ- layers

- 80-90 %, benign teratoma
- 20-10 %, malignant teratoma