

# Neoplasia II: Tumor Characteristics

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# Neoplasia Outline

- Tumor nomenclature
- Tumor characteristics
- Epidemiology
- Cancer pathogenesis

# Neoplasia Outline

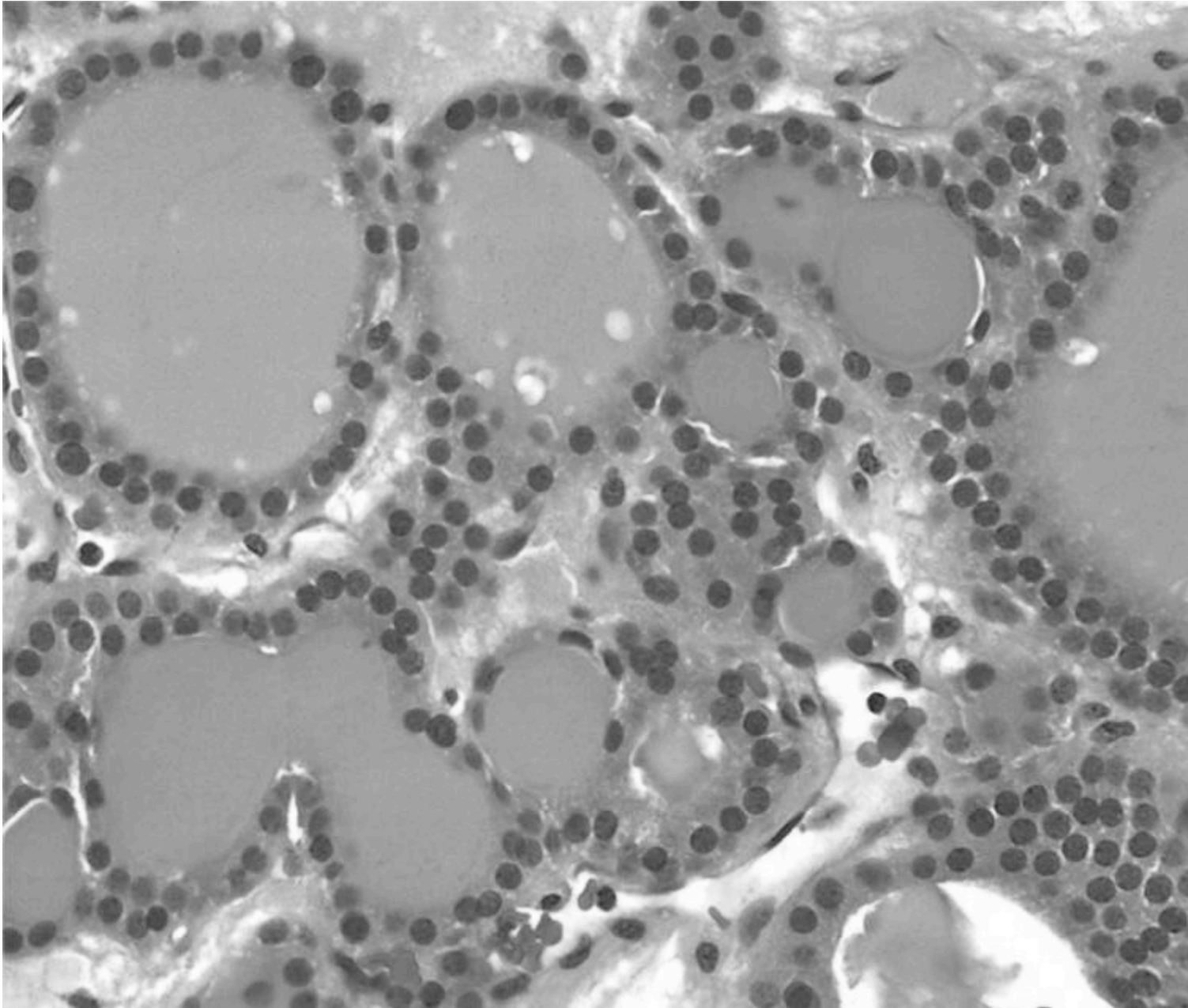
- Tumor nomenclature
- Tumor characteristics
  - Differentiation and anaplasia
  - Rate of growth
  - Local invasion
  - Metastasis

# Neoplasia Outline

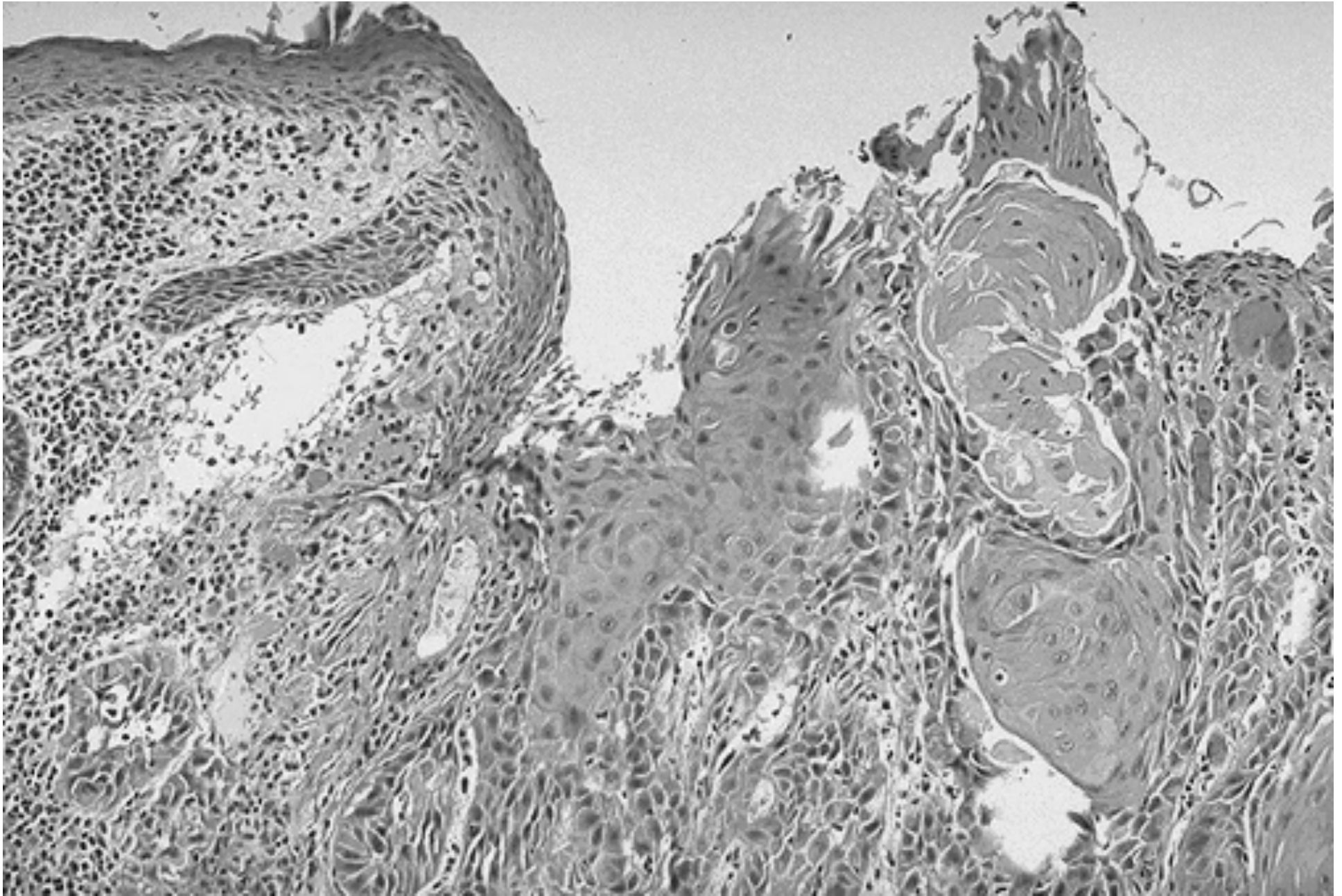
- Tumor nomenclature
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# Differentiation and Anaplasia

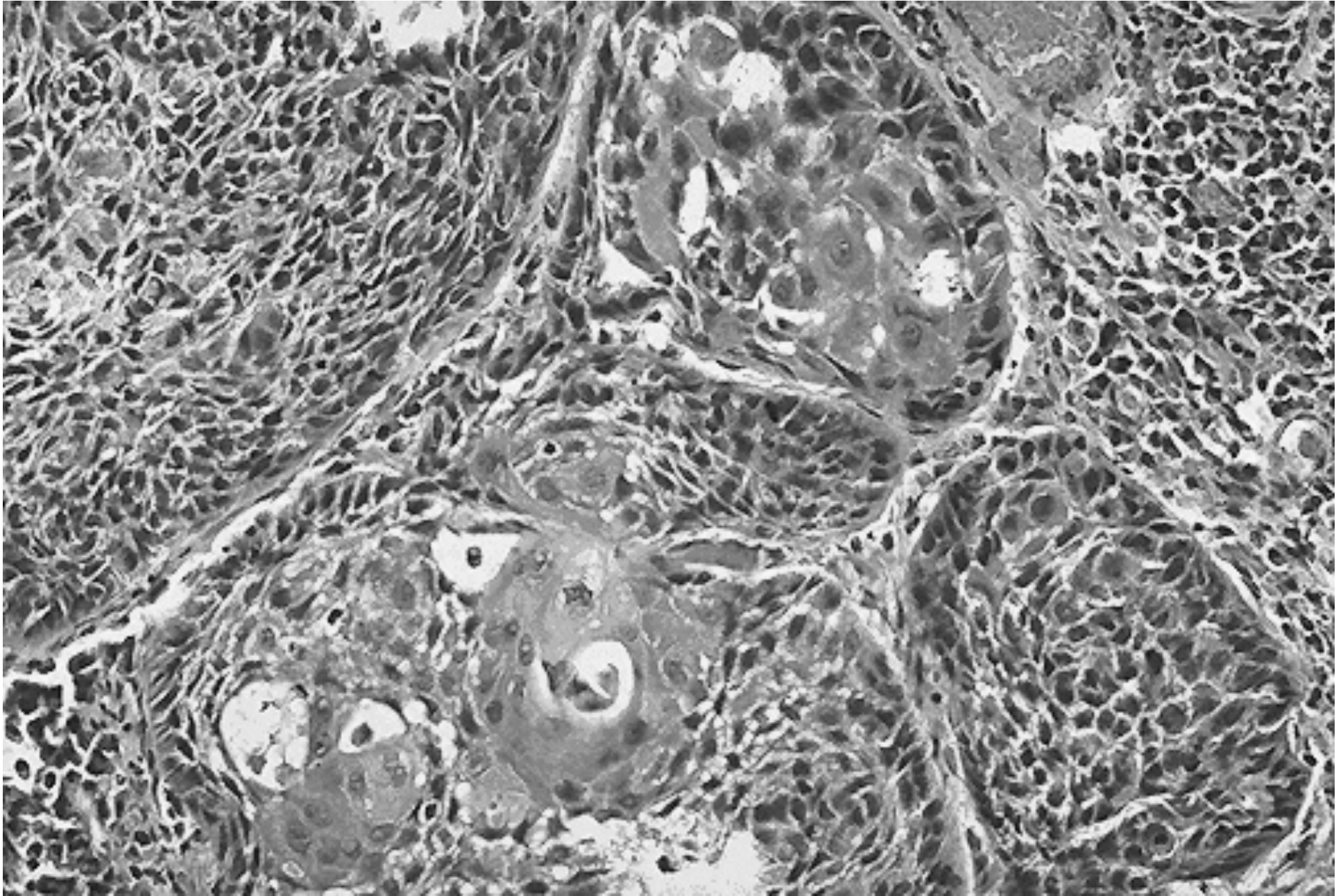
- Differentiation = how much the tumor cells resemble their cells of origin
  - Well-differentiated: closely resembles
  - Moderately-differentiated: sort of resembles
  - Poorly-differentiated: doesn't resemble
- Benign tumors are usually well-differentiated
- Malignant tumors can show any level of differentiation



Thyroid adenoma (well-differentiated)

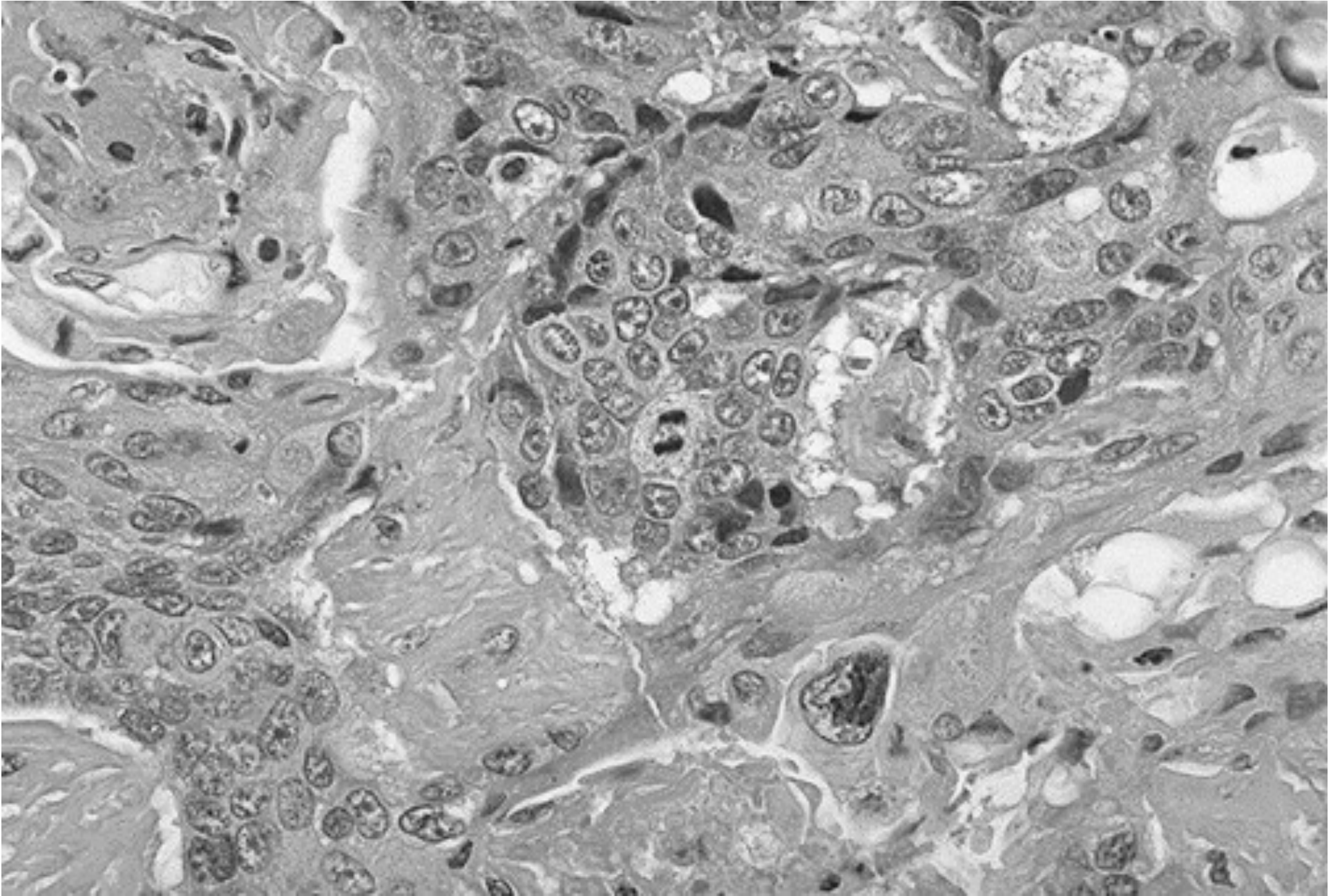


Squamous cell carcinoma, well-differentiated

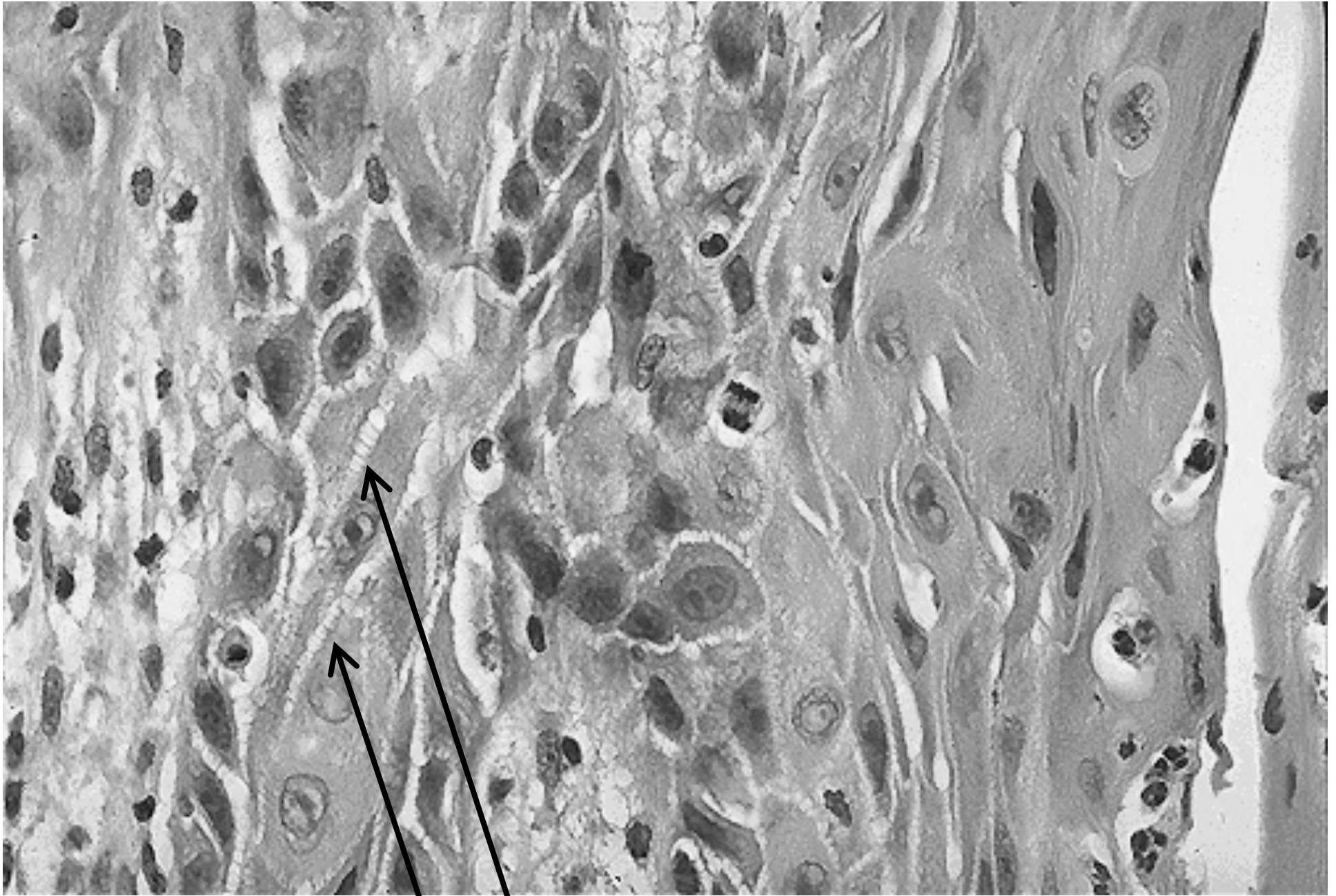


Squamous cell carcinoma, moderately-differentiated





Squamous cell carcinoma, poorly-differentiated



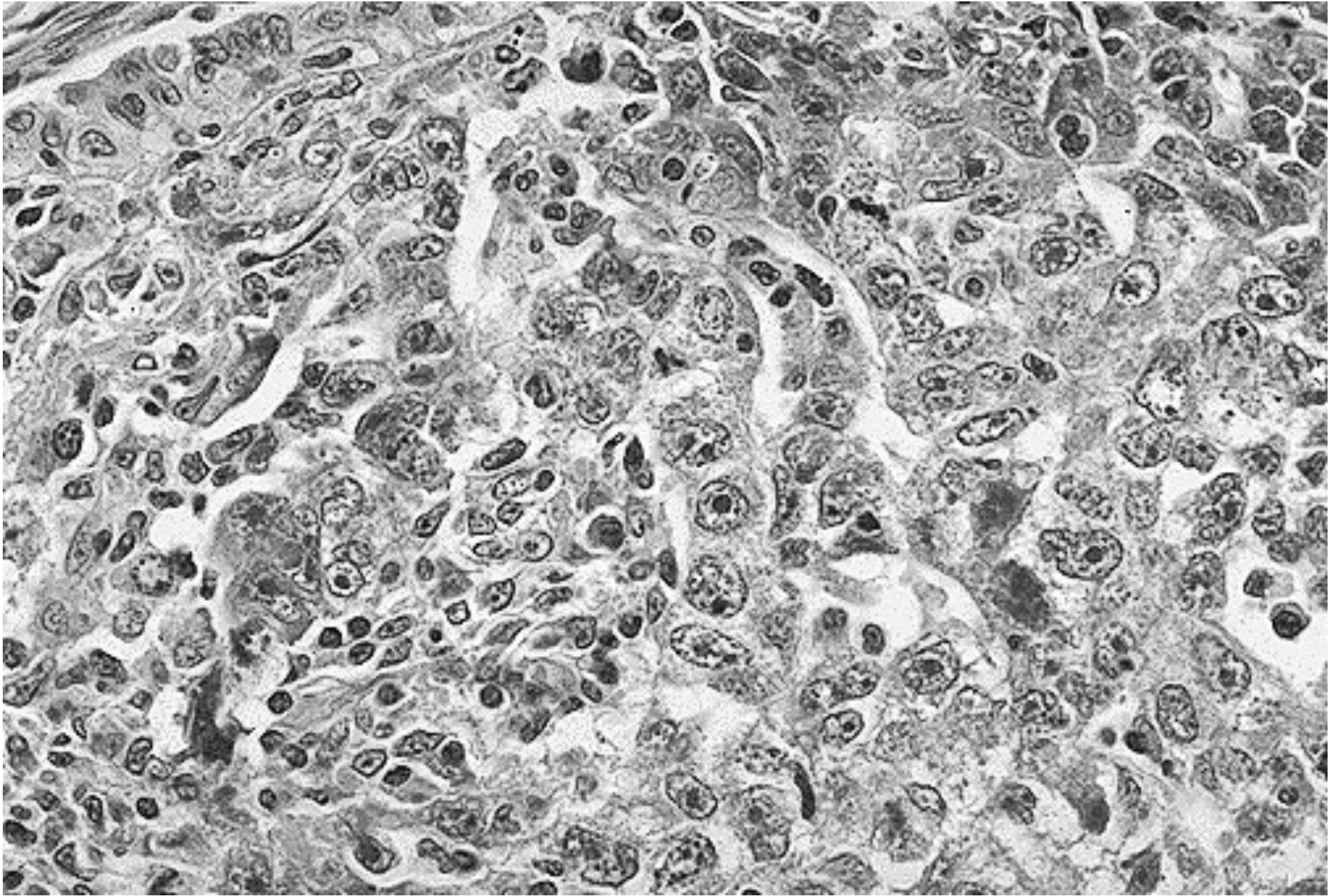
Intercellular bridges

# Anaplasia: a state of complete un-differentiation

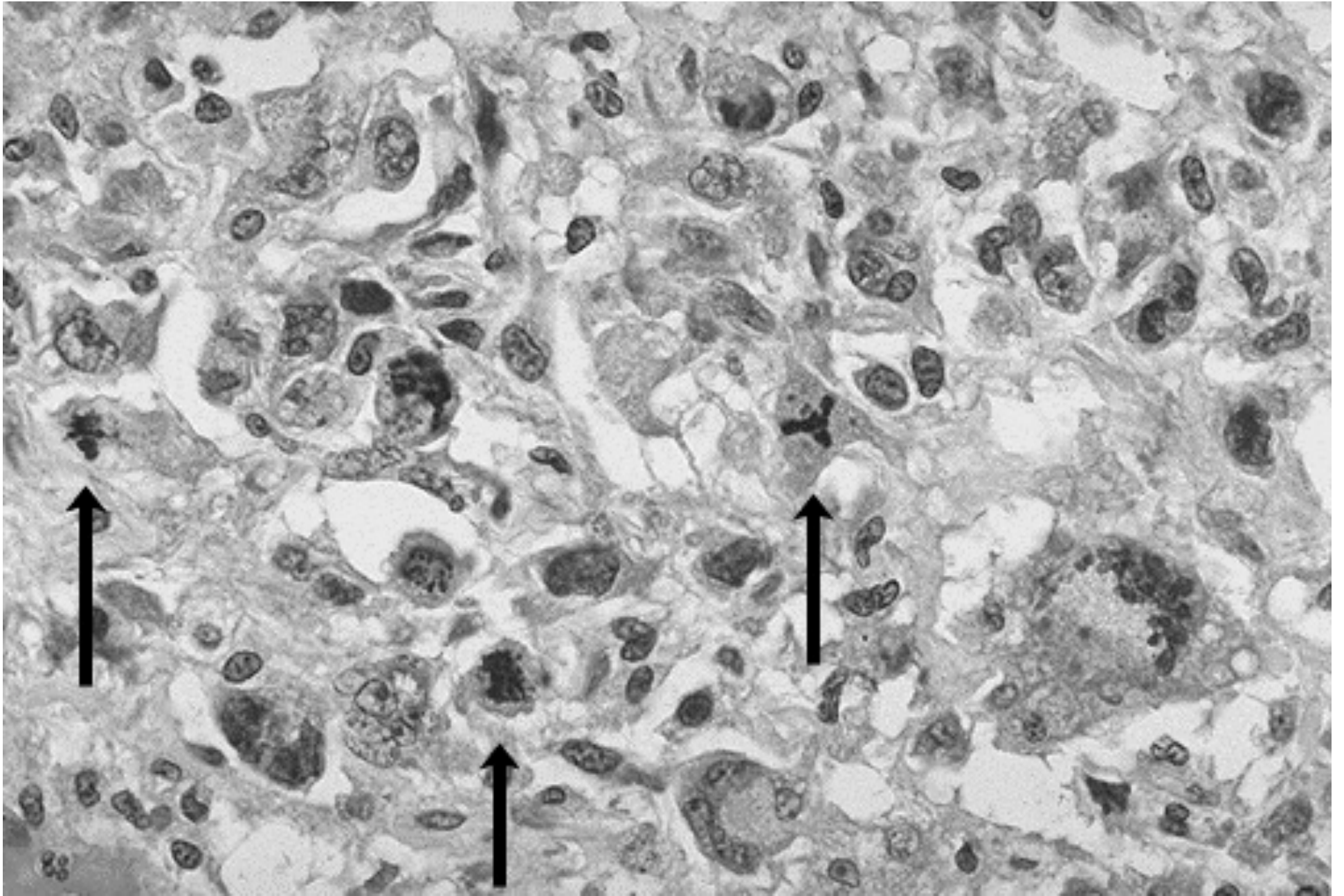
- Literally, to form (-plasia) backwards (ana-)
- Misnomer! Cells don't de-differentiate.
- Just means cells are very poorly-differentiated
- Almost always indicates malignancy

## Anaplastic cells show:

- Pleomorphism
- Hyperchromatic, large nuclei
- Bizarre nuclear shapes, distinct nucleoli
- Lots of mitoses, and atypical mitoses
- Architectural anarchy



Anaplastic carcinoma



Abnormal mitoses

# Dysplasia = disorderly (dys-) growth (-plasia)

- “Dysplasia” is used to describe disorderly changes in non-neoplastic epithelial cells
- Graded as mild, moderate or severe
  - Mild-moderate: usually reversible
  - Severe: usually progresses to carcinoma in situ (CIS)
- Next step after CIS: invasive carcinoma

## Dysplastic cells show:

- Pleomorphism
- Hyperchromatic, large nuclei
- Lots of mitoses
- Architectural anarchy



Q. Wait a minute, dysplasia sounds suspiciously similar to differentiation – what's the difference?

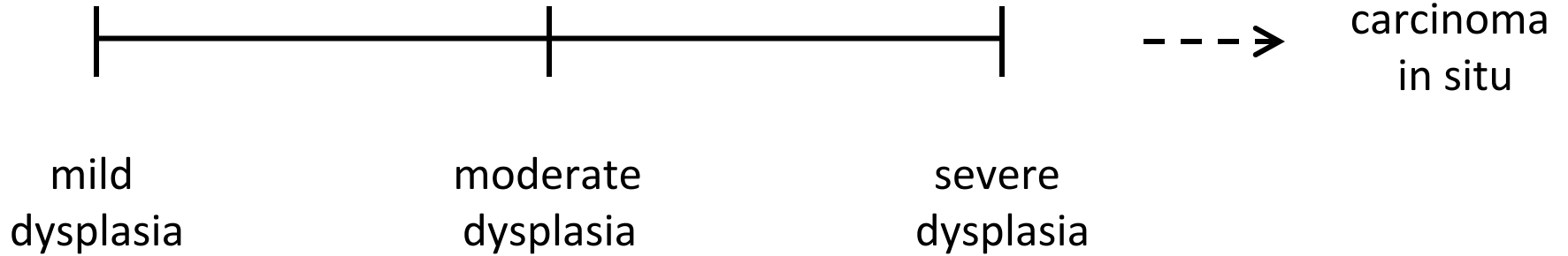
Q. Wait a minute, dysplasia sounds suspiciously similar to differentiation – what's the difference?

A. Both terms describe whether cells look normal or not!

But:

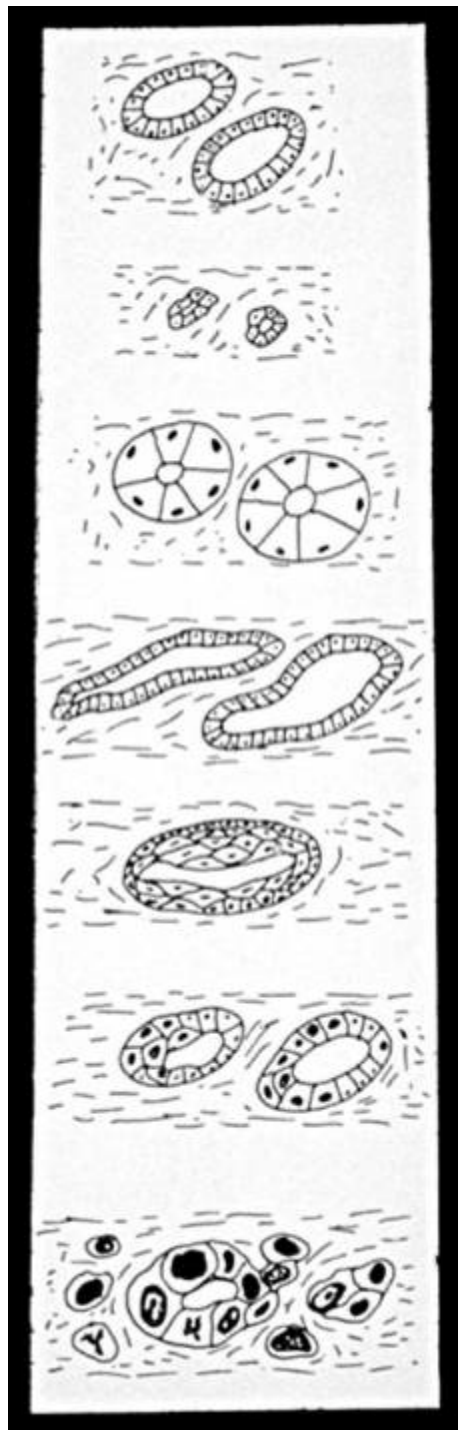
- “Differentiation” is only used with neoplastic cells, and “Dysplasia” is only used with non-neoplastic cells!
- “Dysplasia” is only used with epithelial cells, but “Differentiation” can apply to any cell type.

## Non-neoplastic epithelial cells

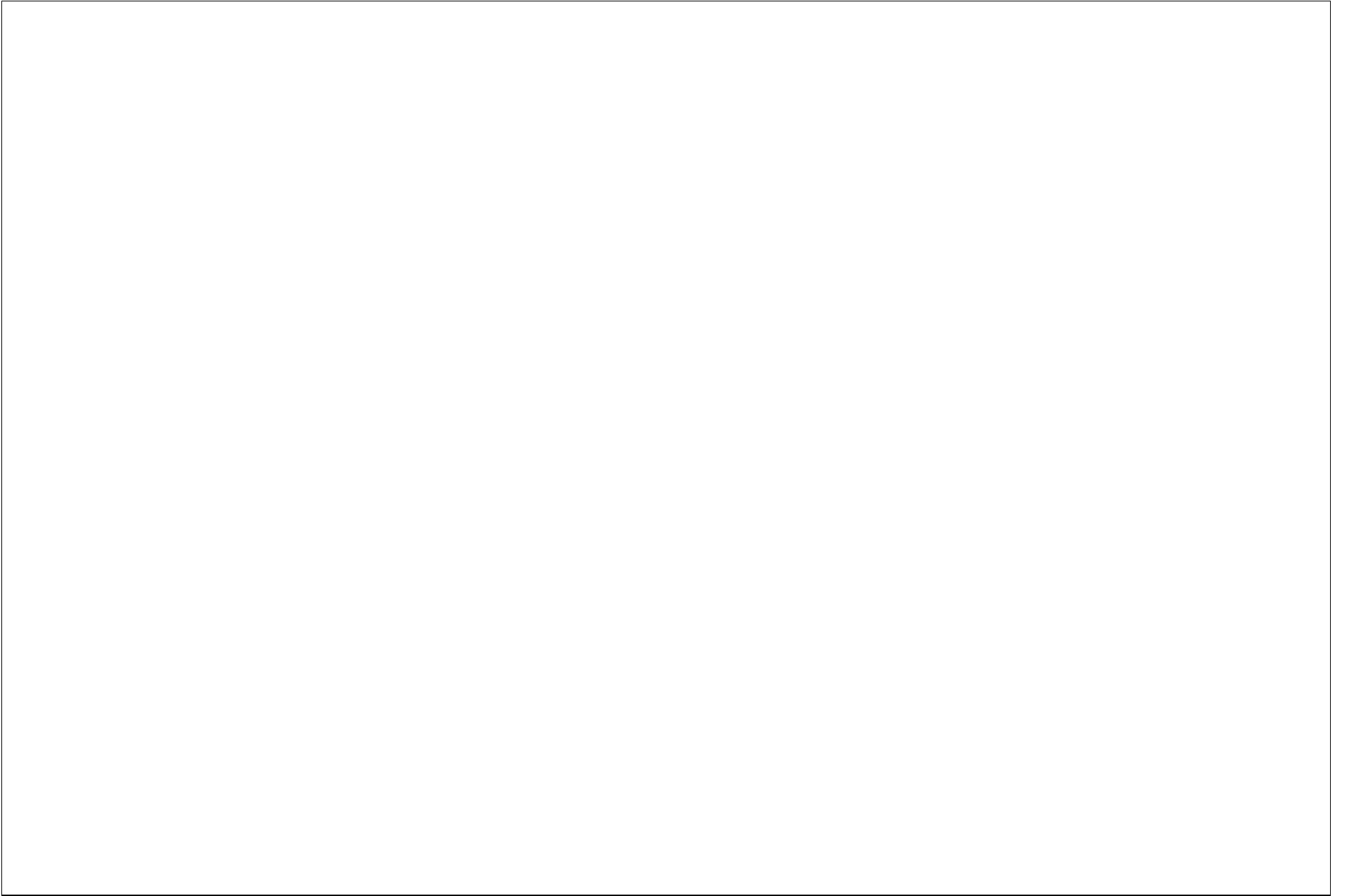


## Neoplastic cells





Dysplasia



Normal glands



Normal gland

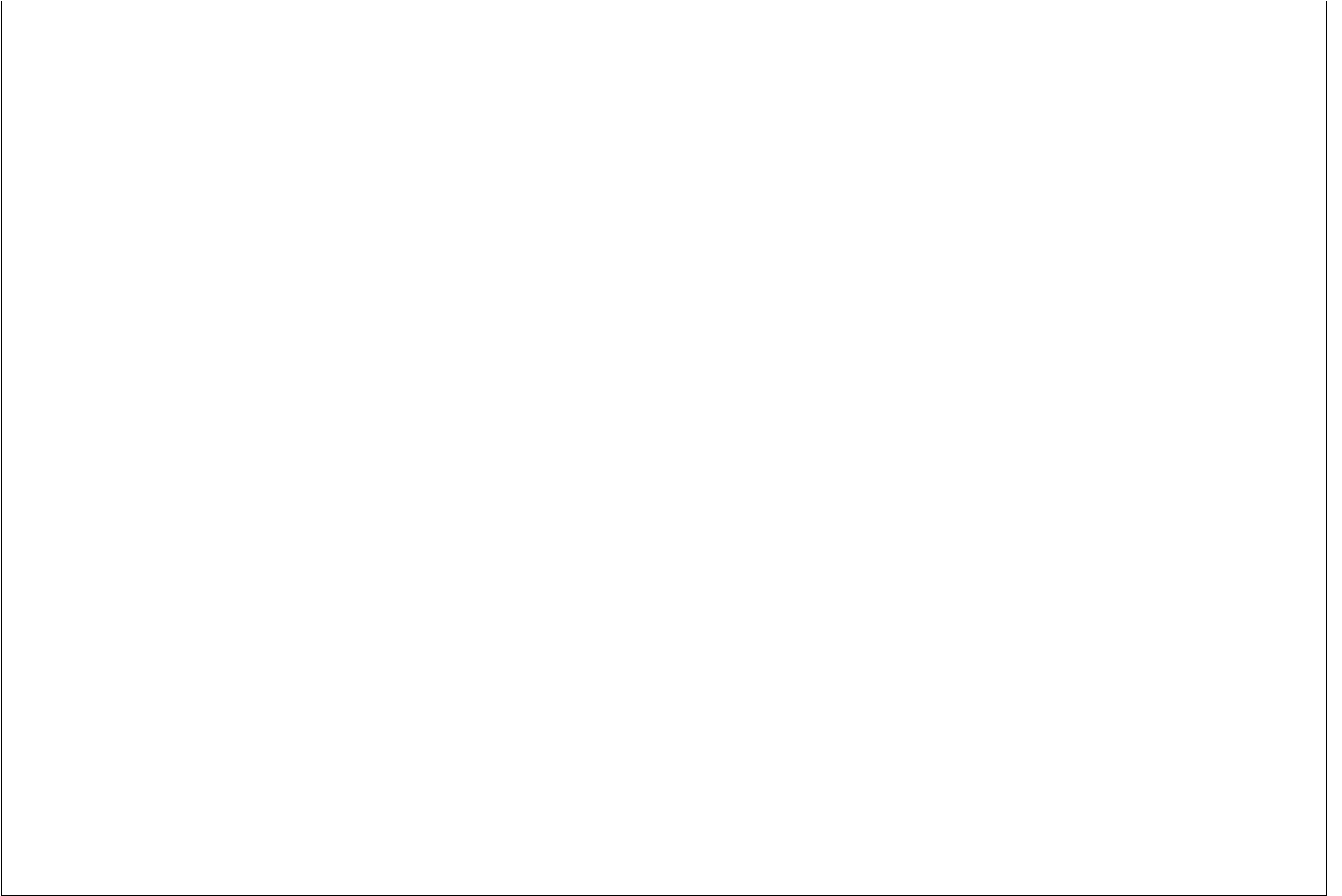


Mild dysplasia

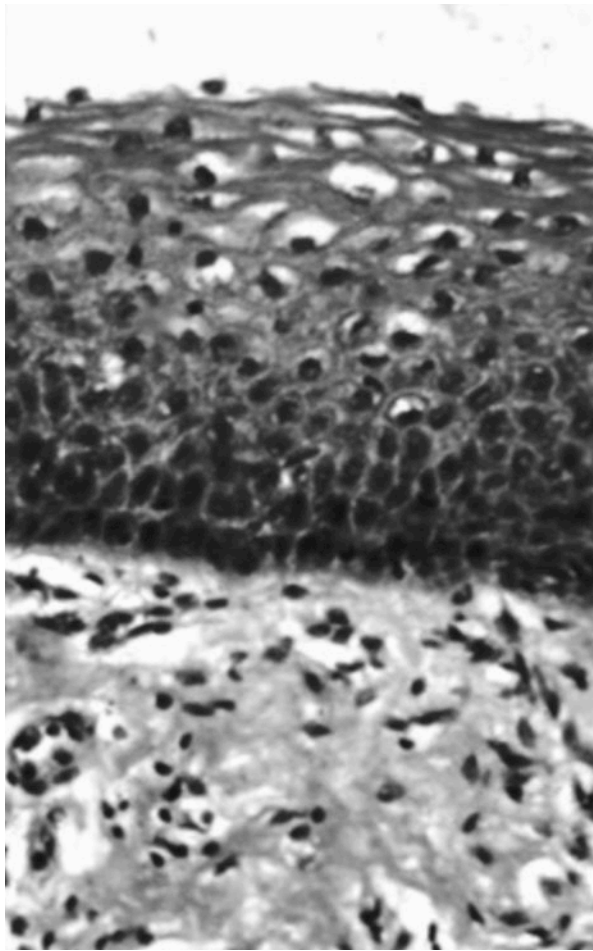




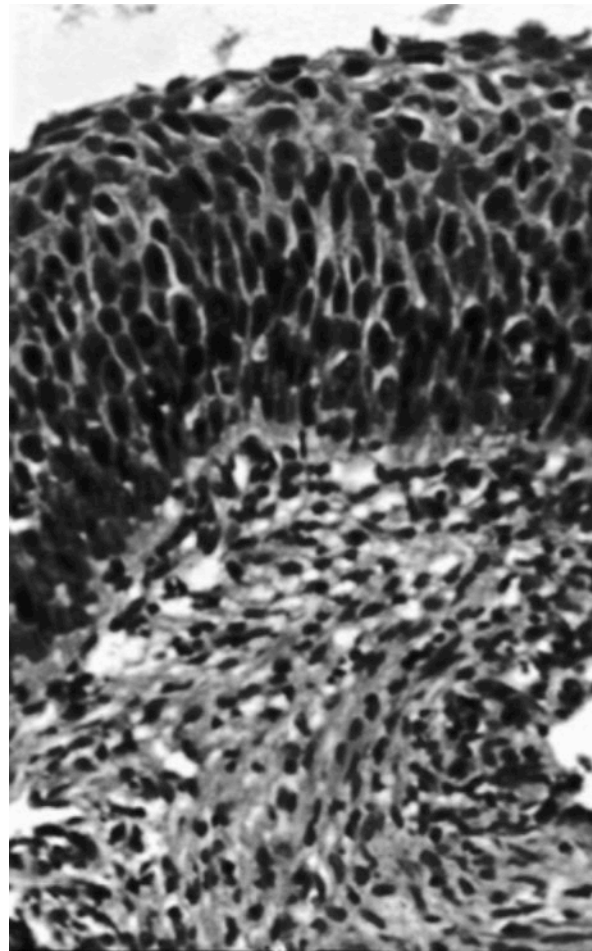
Moderate dysplasia



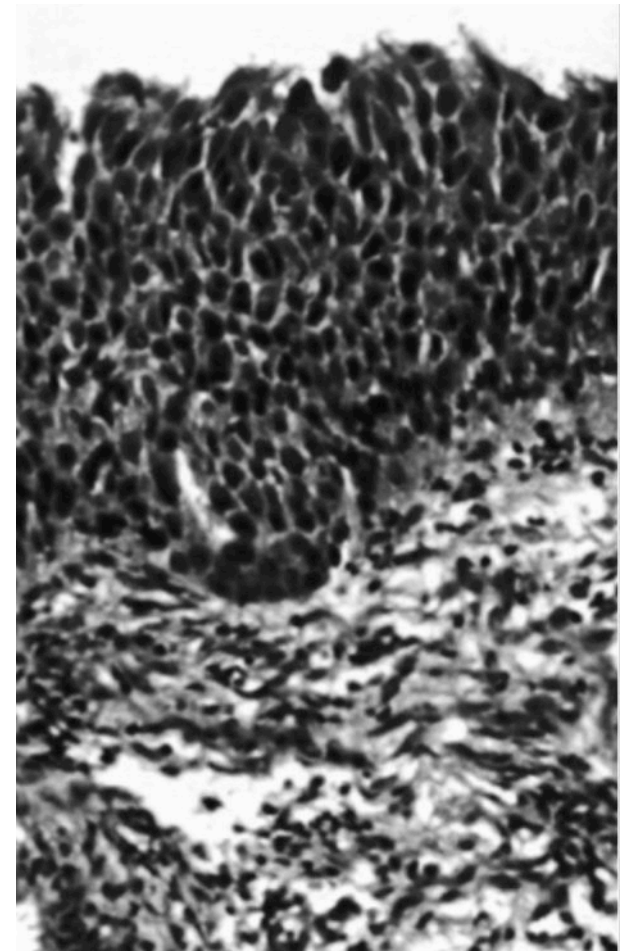
Severe dysplasia



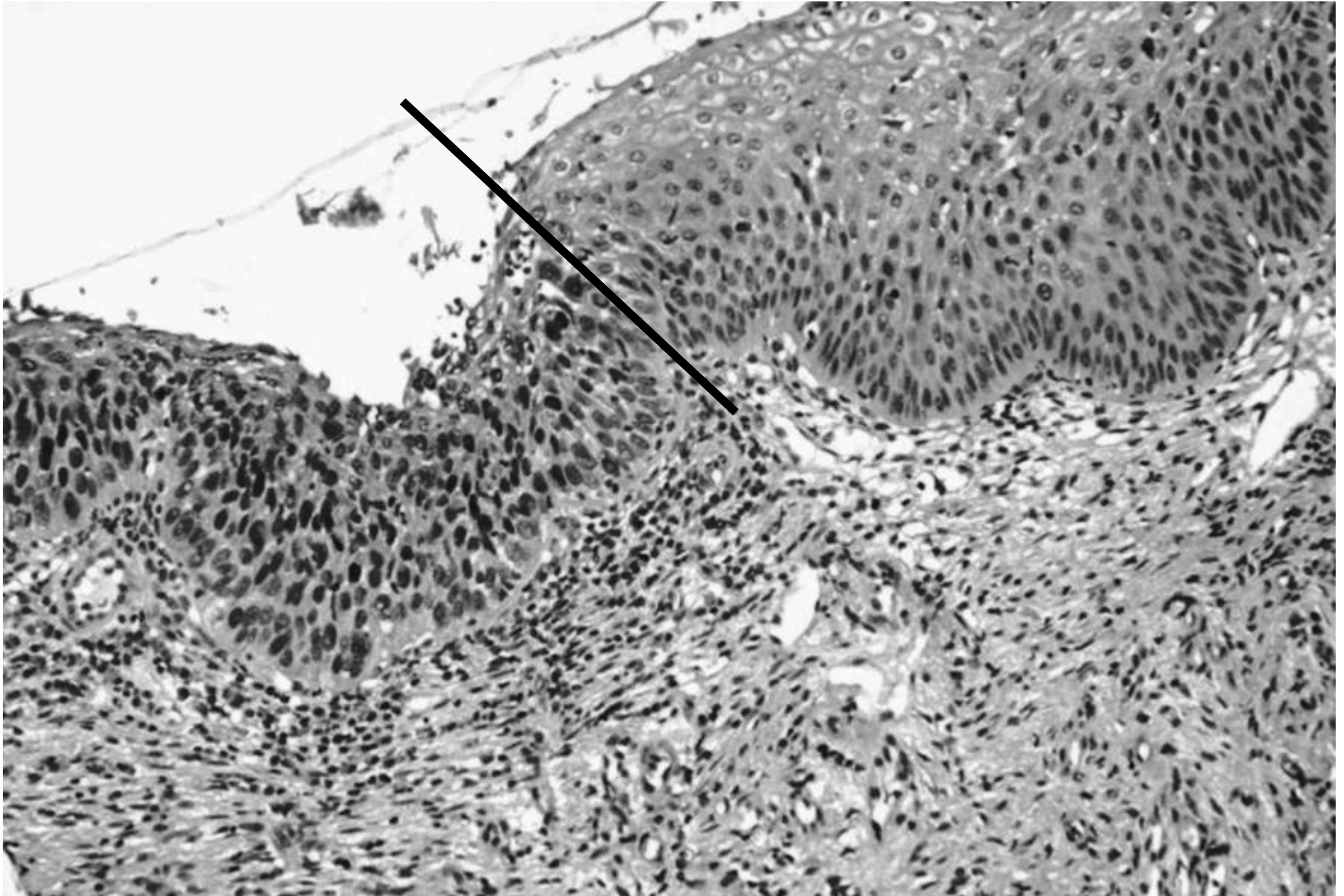
Normal squamous  
epithelium



Moderate  
dysplasia

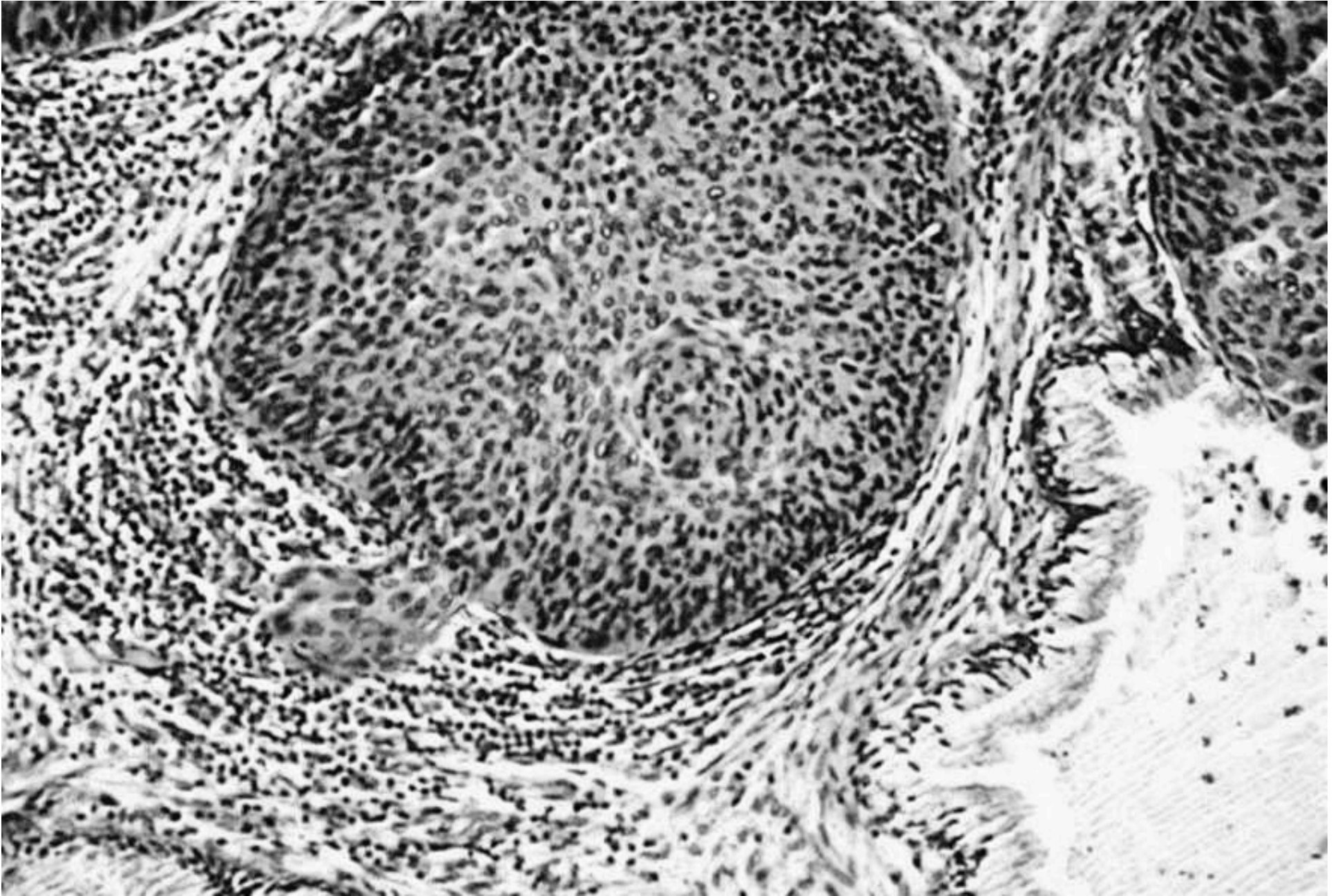


Severe dysplasia



Dysplastic epithelium

Normal epithelium



Invasive squamous cell carcinoma

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  - Differentiation and anaplasia
  - Rate of growth

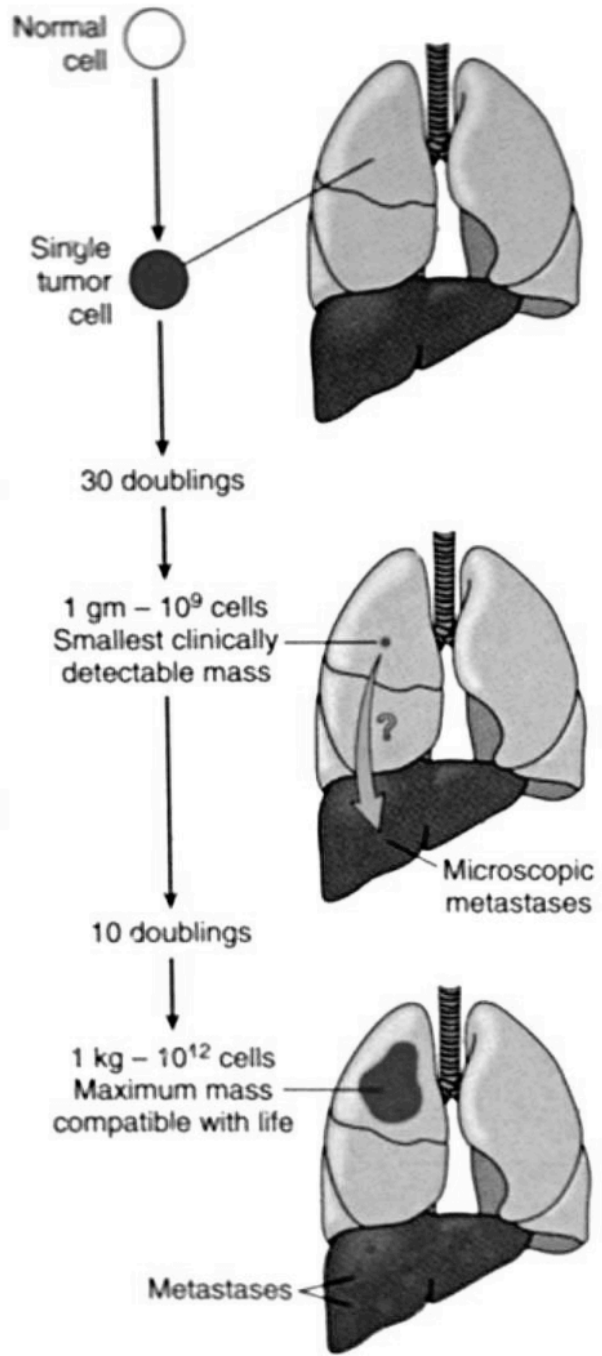
# Generalizations about Growth

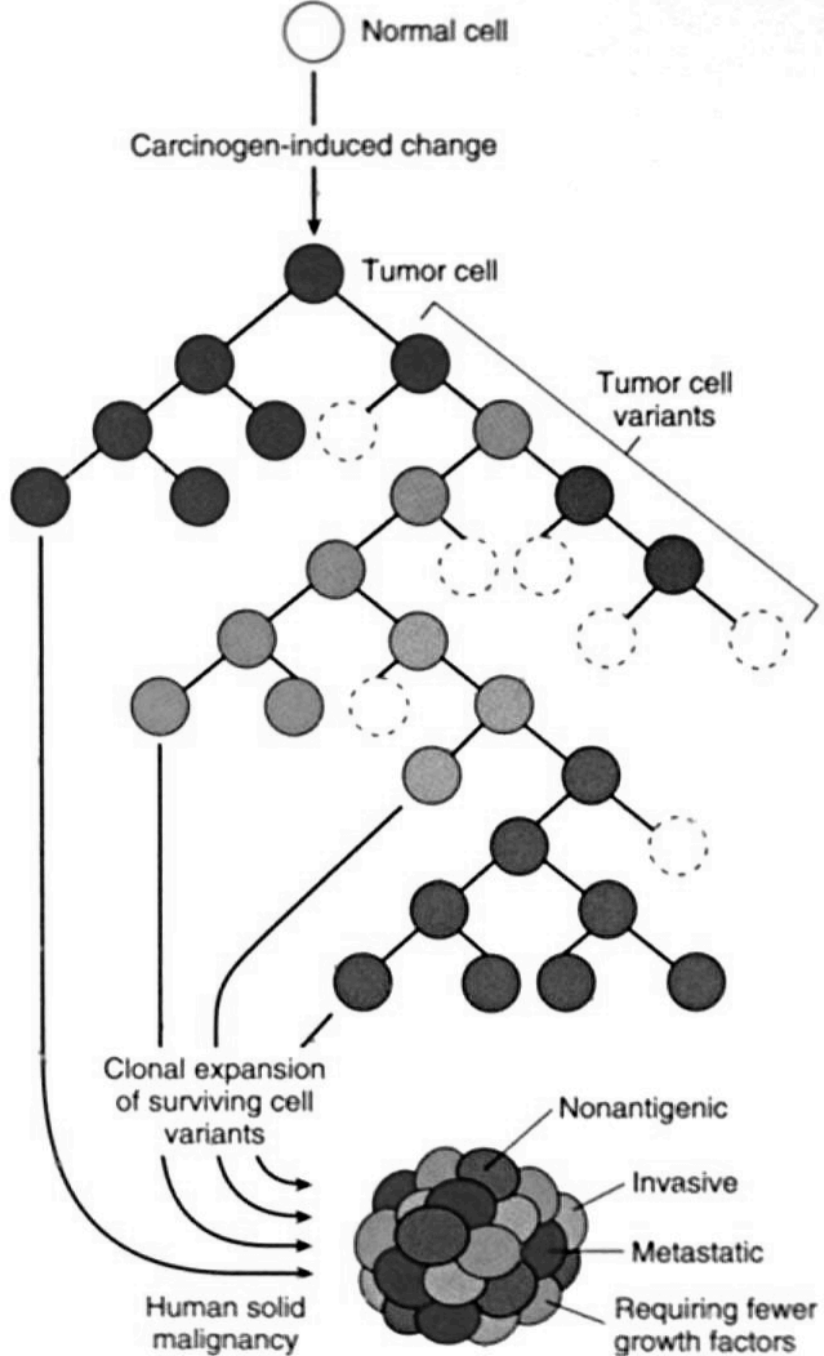
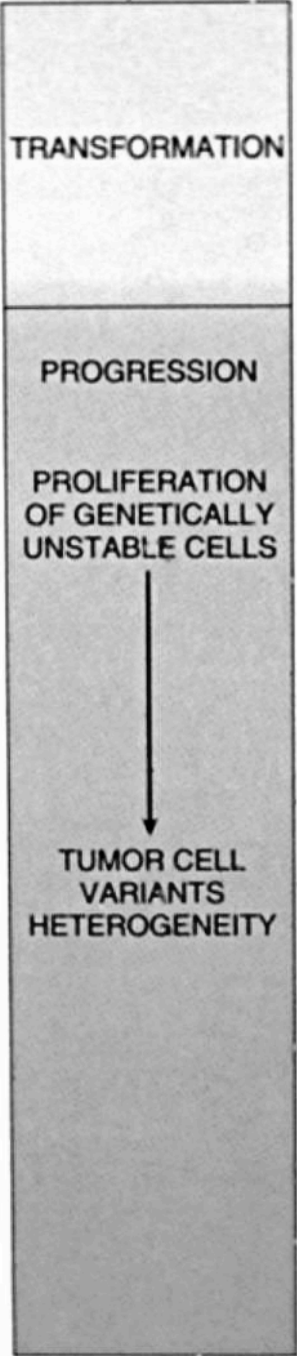
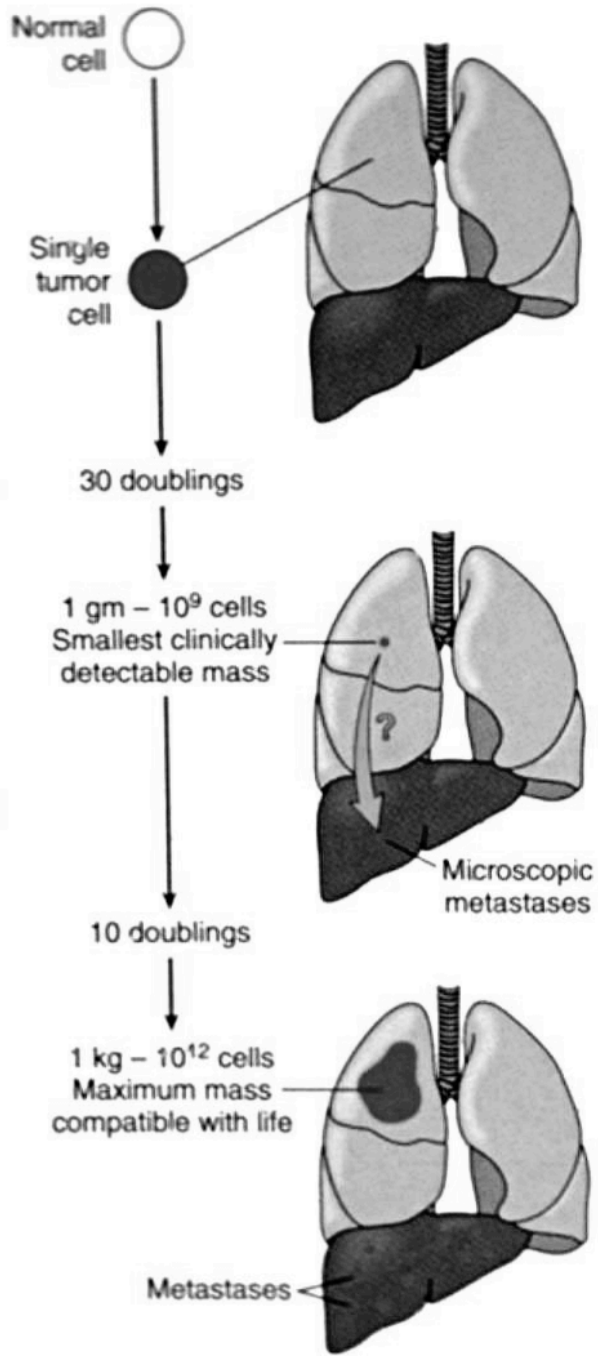
- Malignant tumors grow faster than benign ones.
- Poorly-differentiated tumors grow faster than well-differentiated ones.
- Growth is dependent on:
  - Blood supply
  - Hormonal factors
  - Emergence of aggressive sub-clones

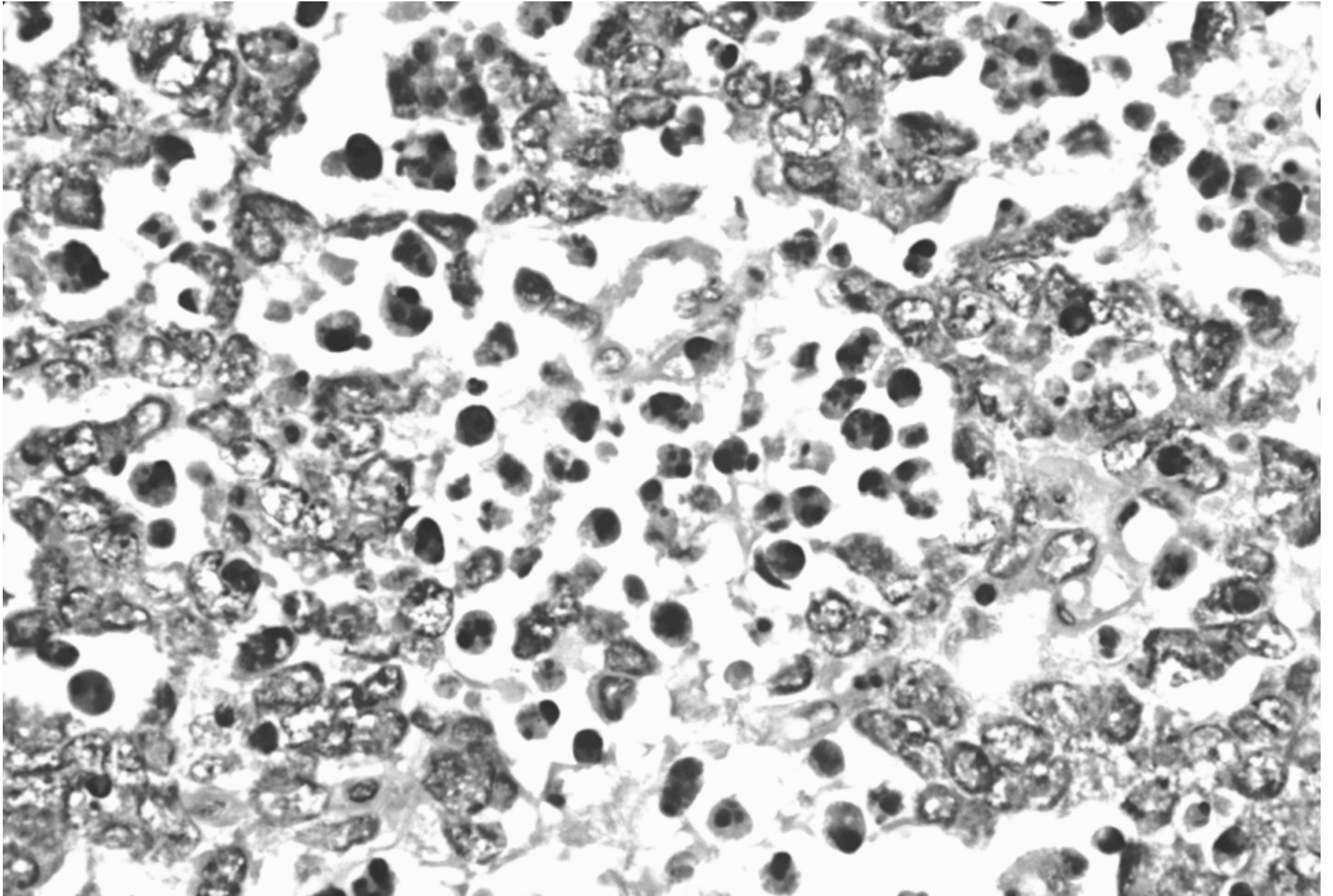
# Growth Fraction

- GF = % of tumor cells that are dividing
- Age of tumor matters
  - Early on (subclinical), GF high.
  - Later (clinically detectable), GF low.
- Type of tumor matters
  - Leukemias, lymphomas, small-cell lung cancer: high GF
  - Breast, colon cancer: low GF
- Important for treatment
  - High GF tumor: treat with chemotherapy/radiation
  - Low GF tumor: treat by debulking



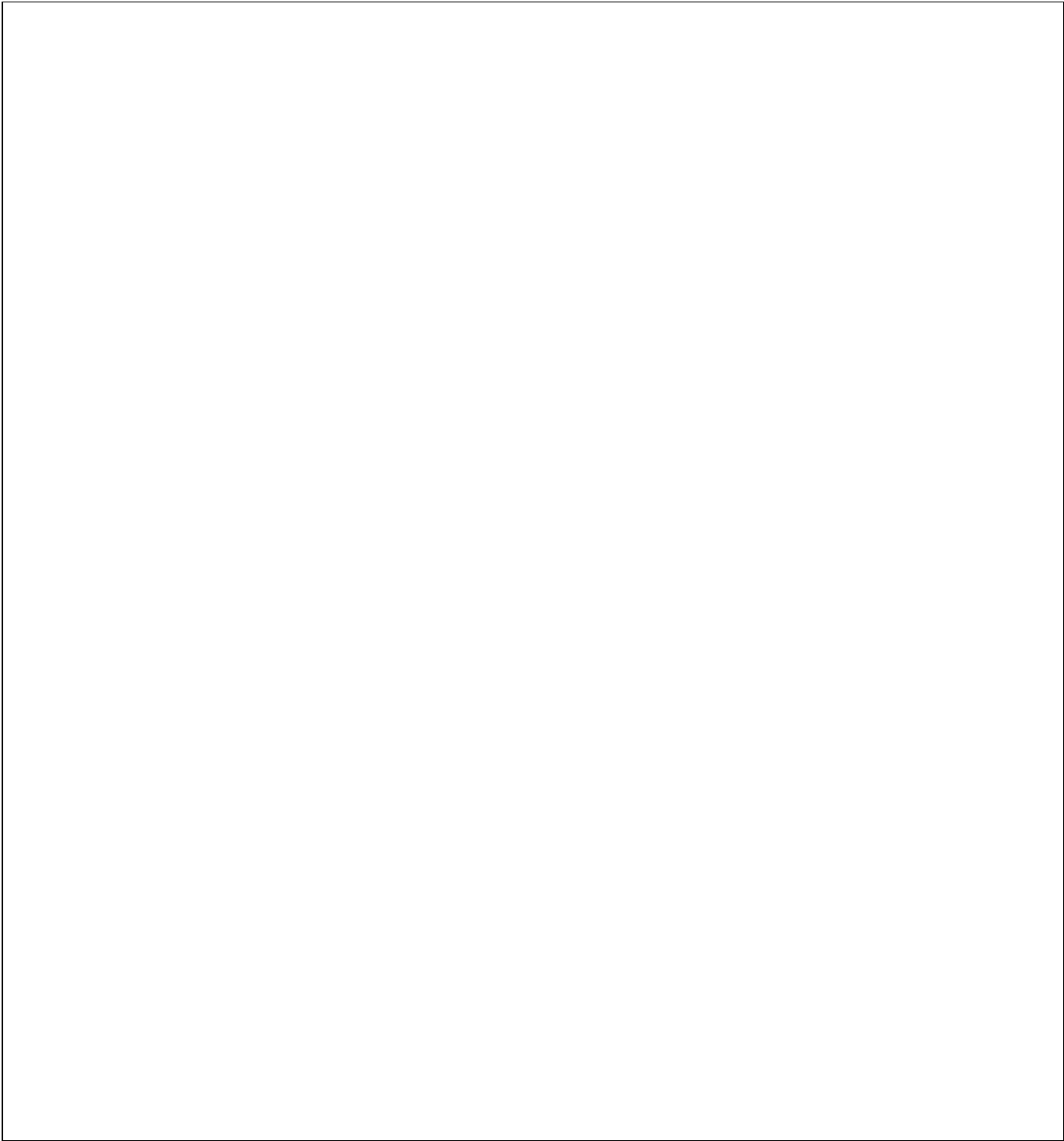


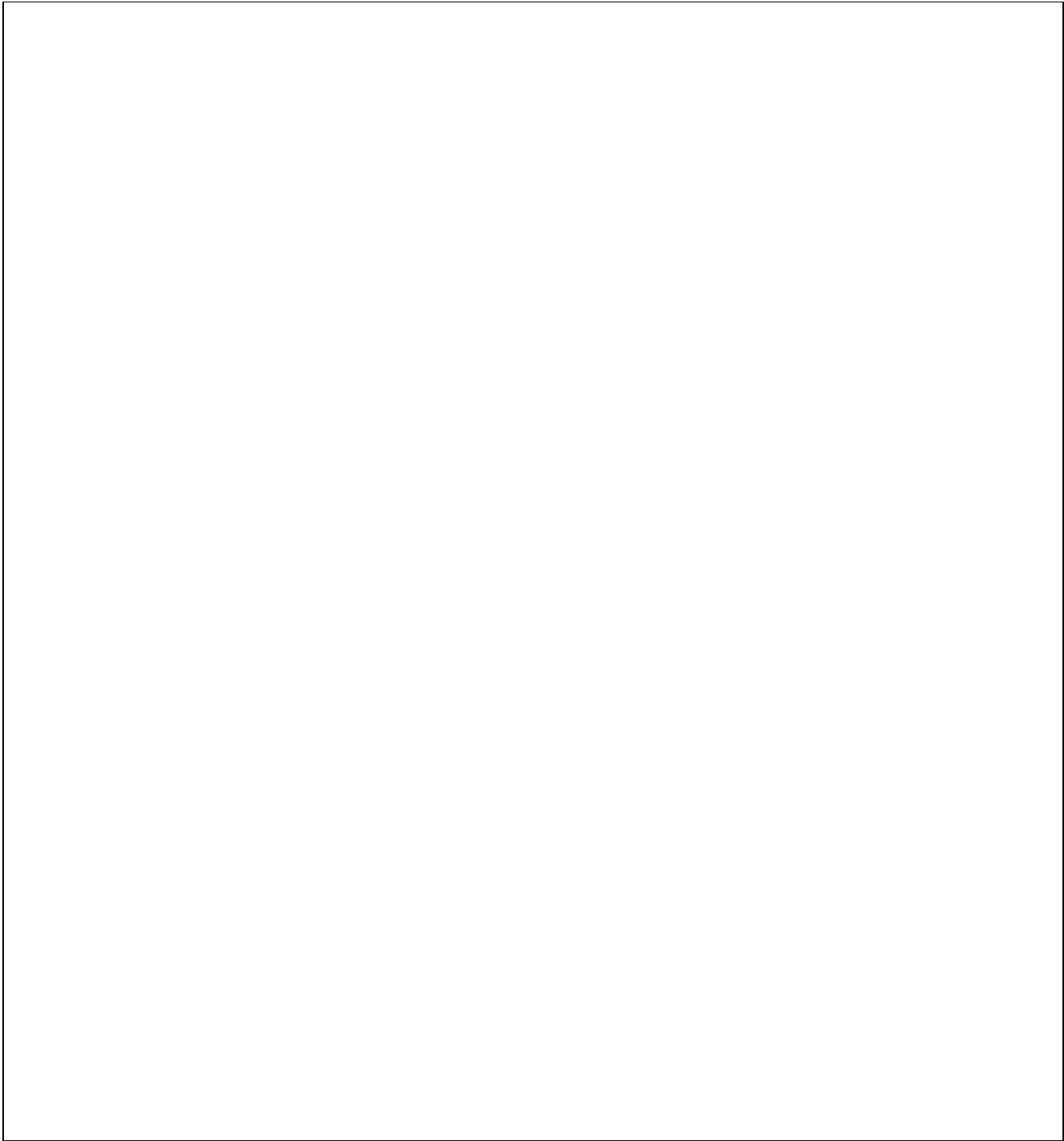




Tumor cells undergoing apoptosis







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# Local Invasion

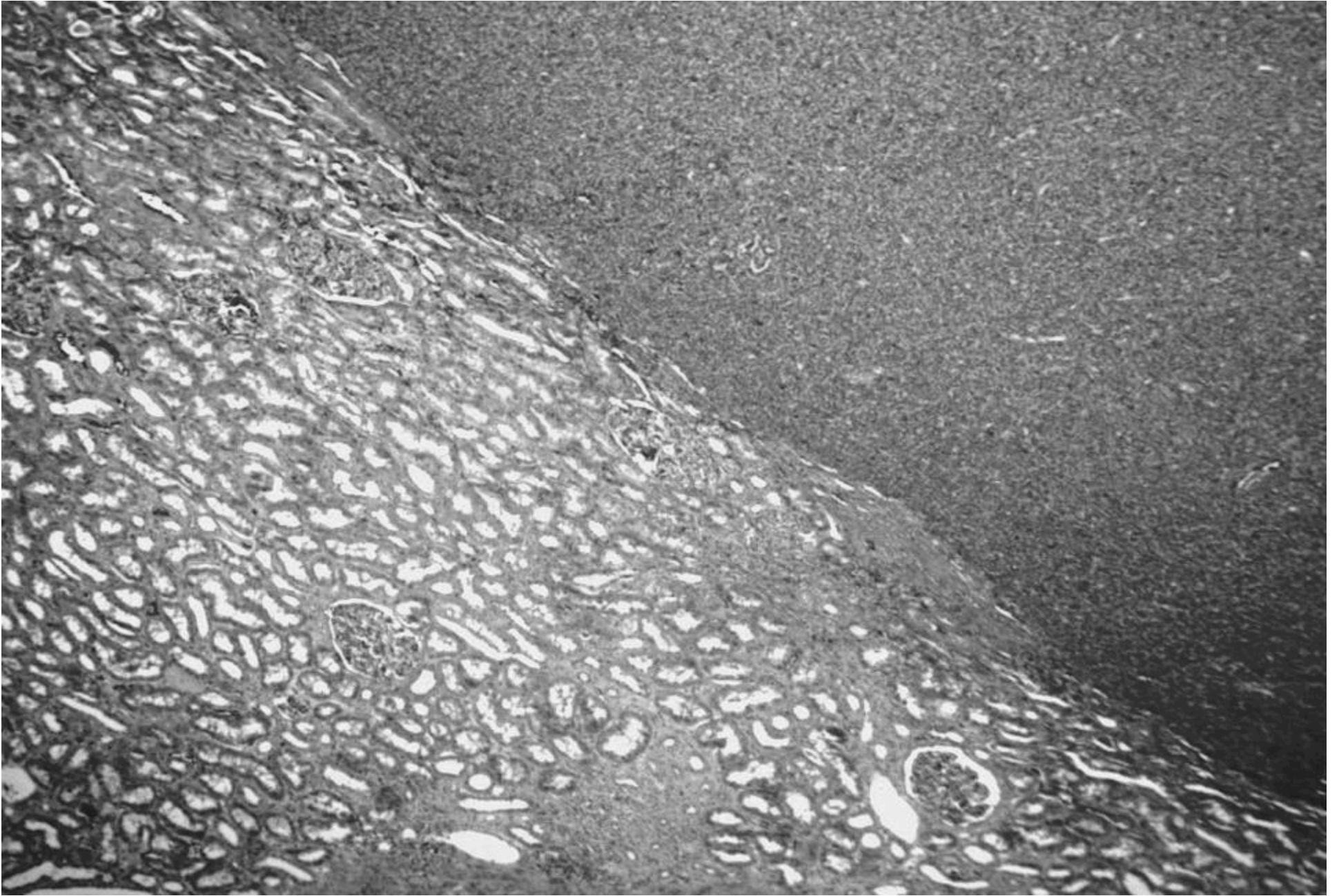
## Benign tumors

- Stay where they are.
- Can't invade or metastasize.
- Usually encapsulated.

## Malignant tumors

- Infiltrate, invade, destroy surrounding tissue.
- Then metastasize to other parts of body.
- Not encapsulated.

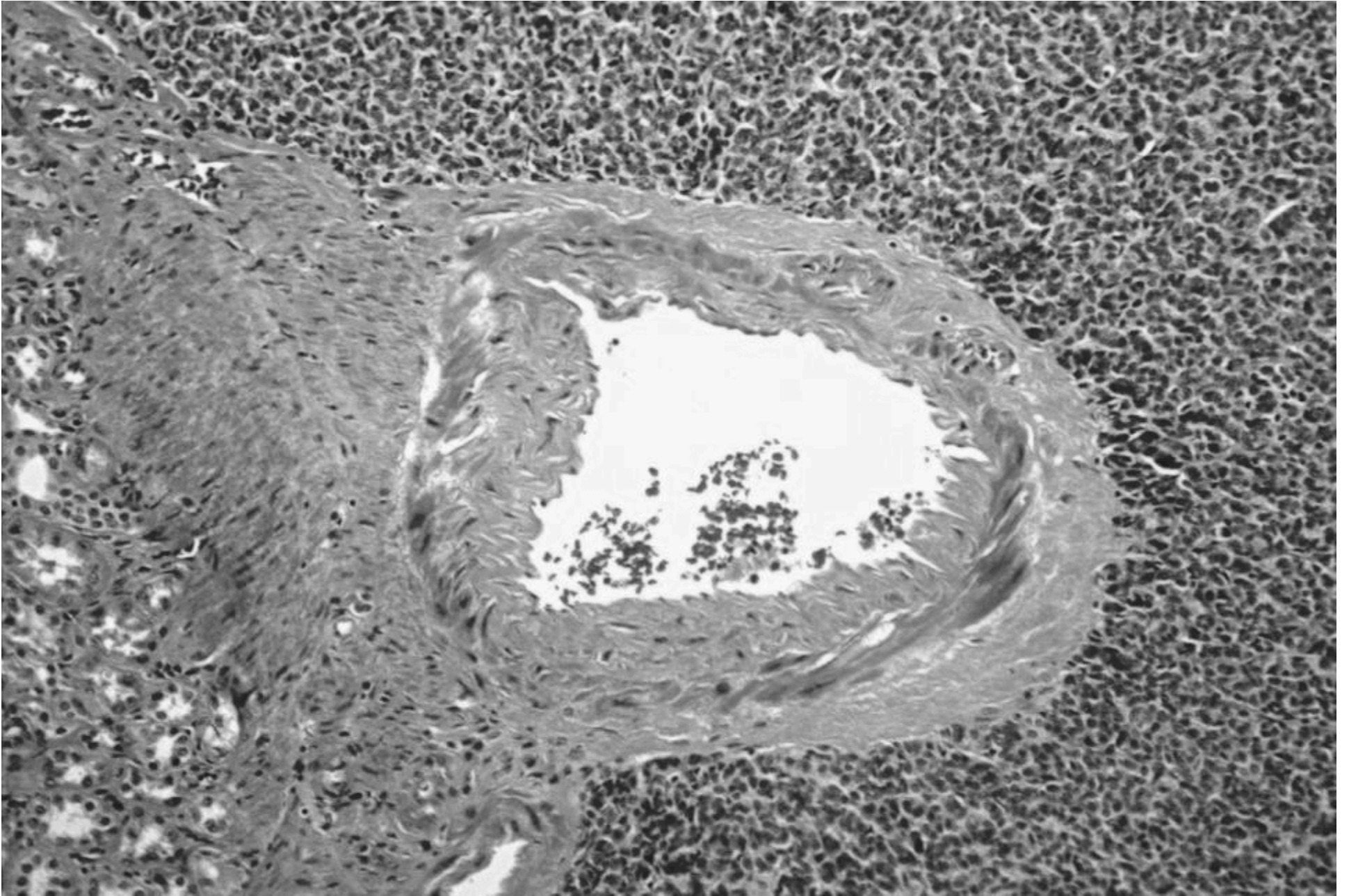




Malignant tumor invading kidney



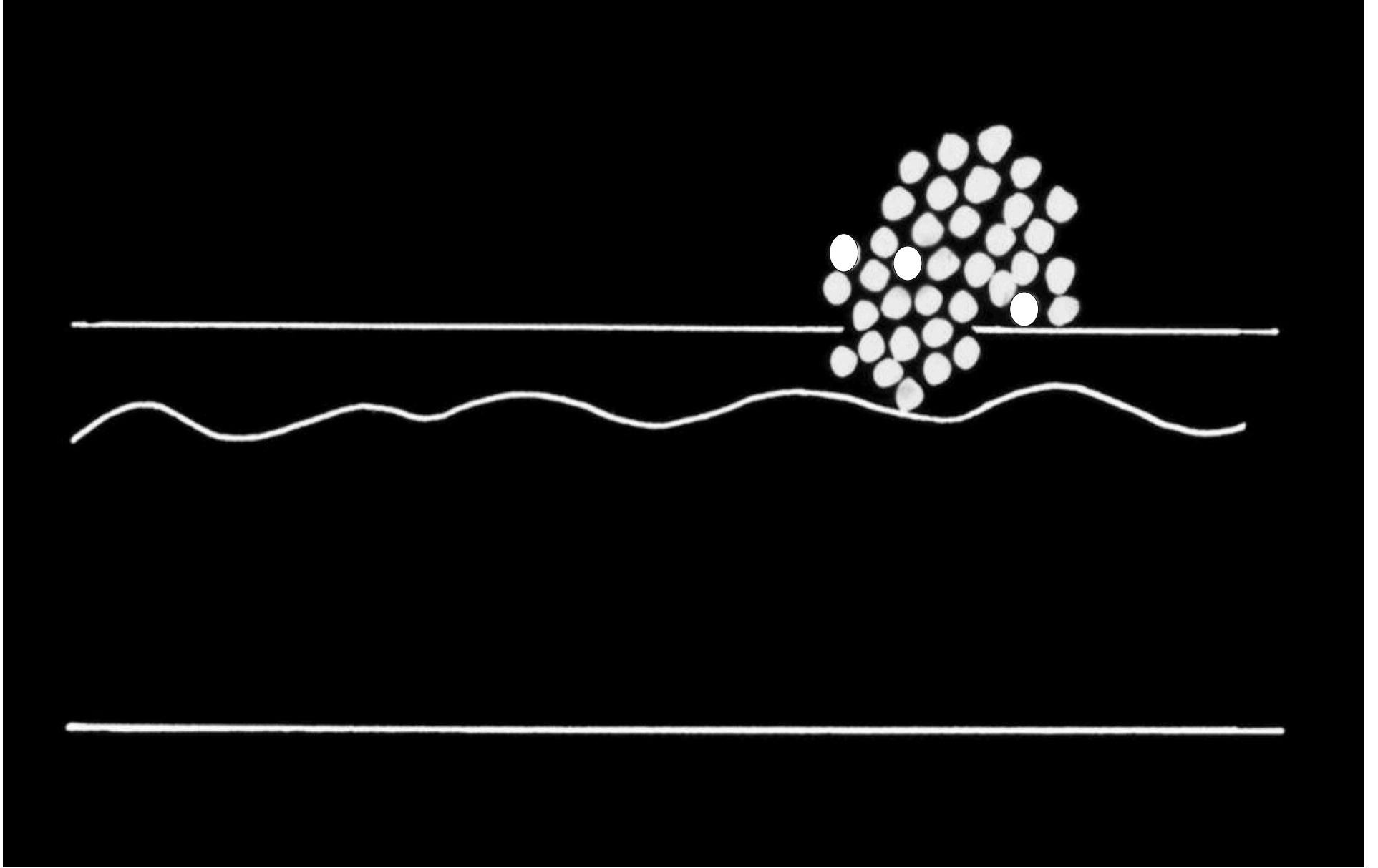
Malignant tumor invading kidney

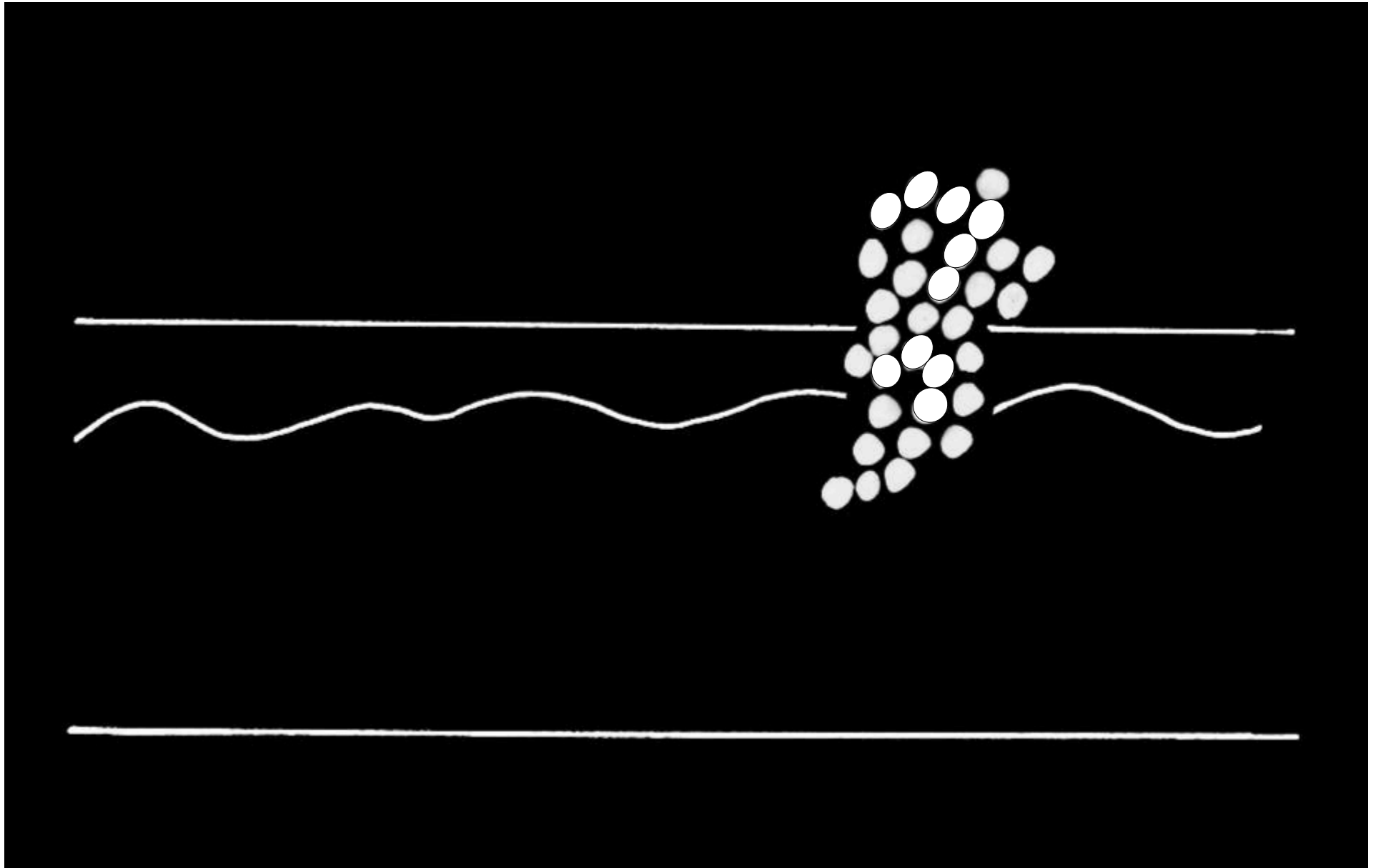


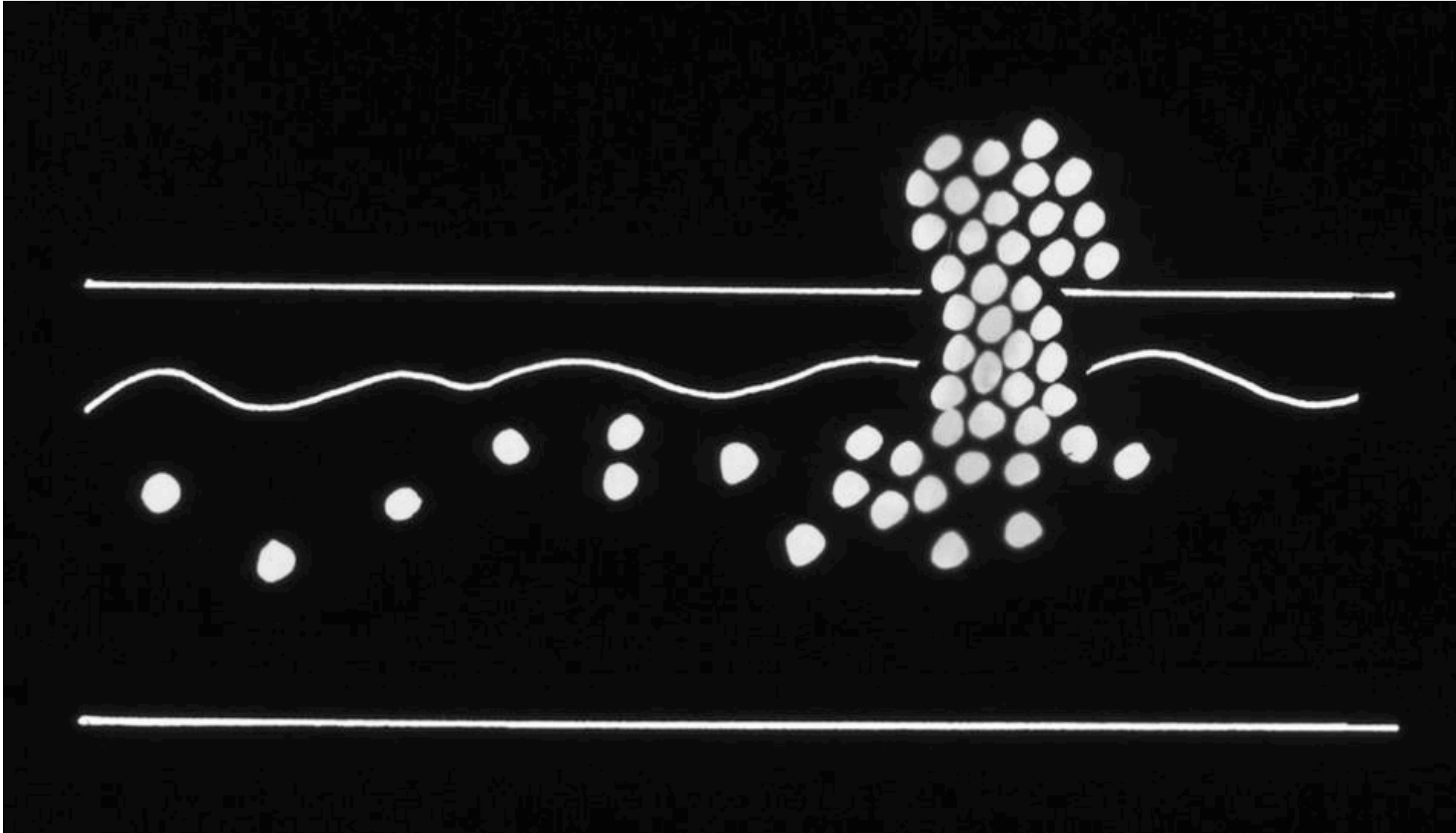
Malignant tumor invading kidney

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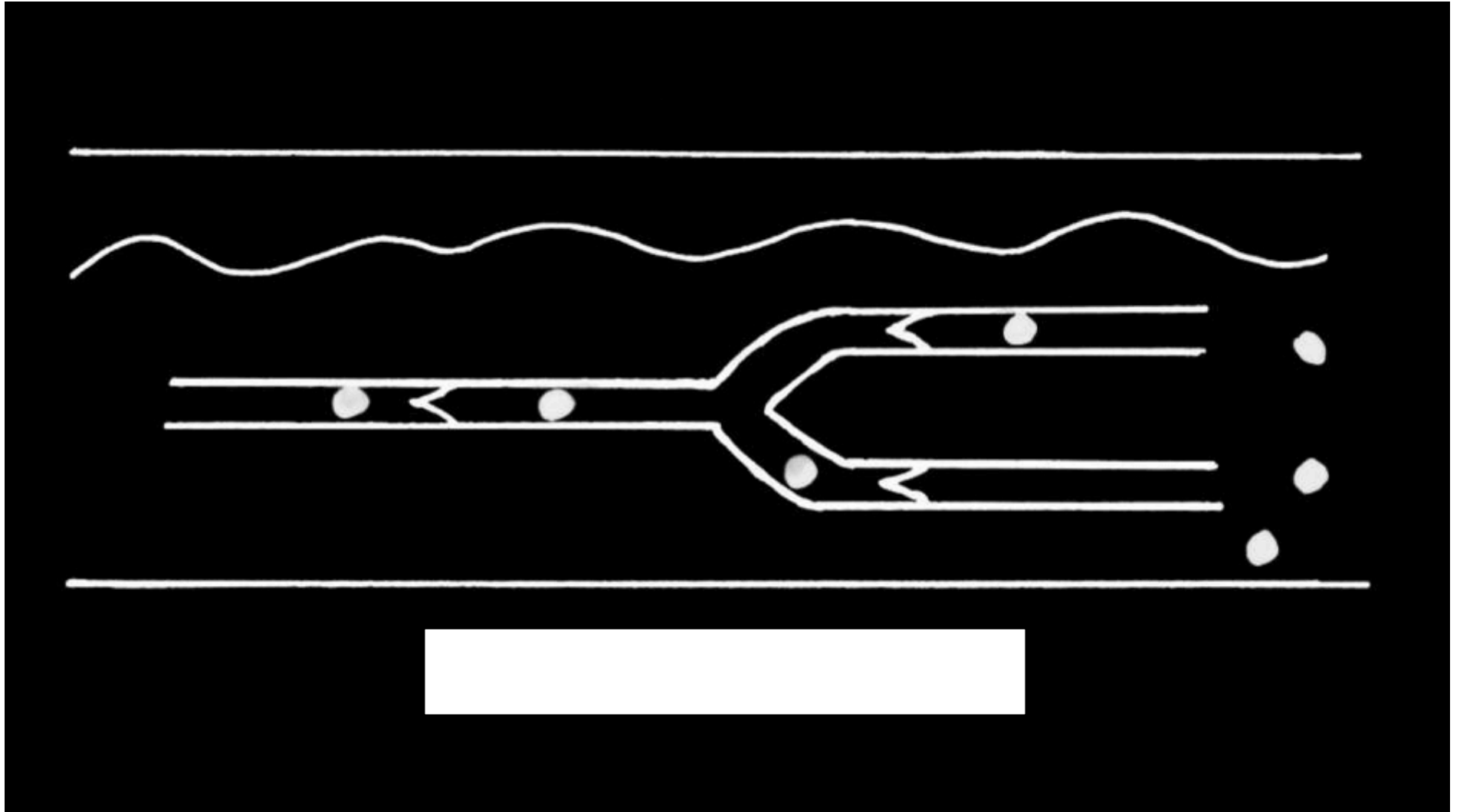
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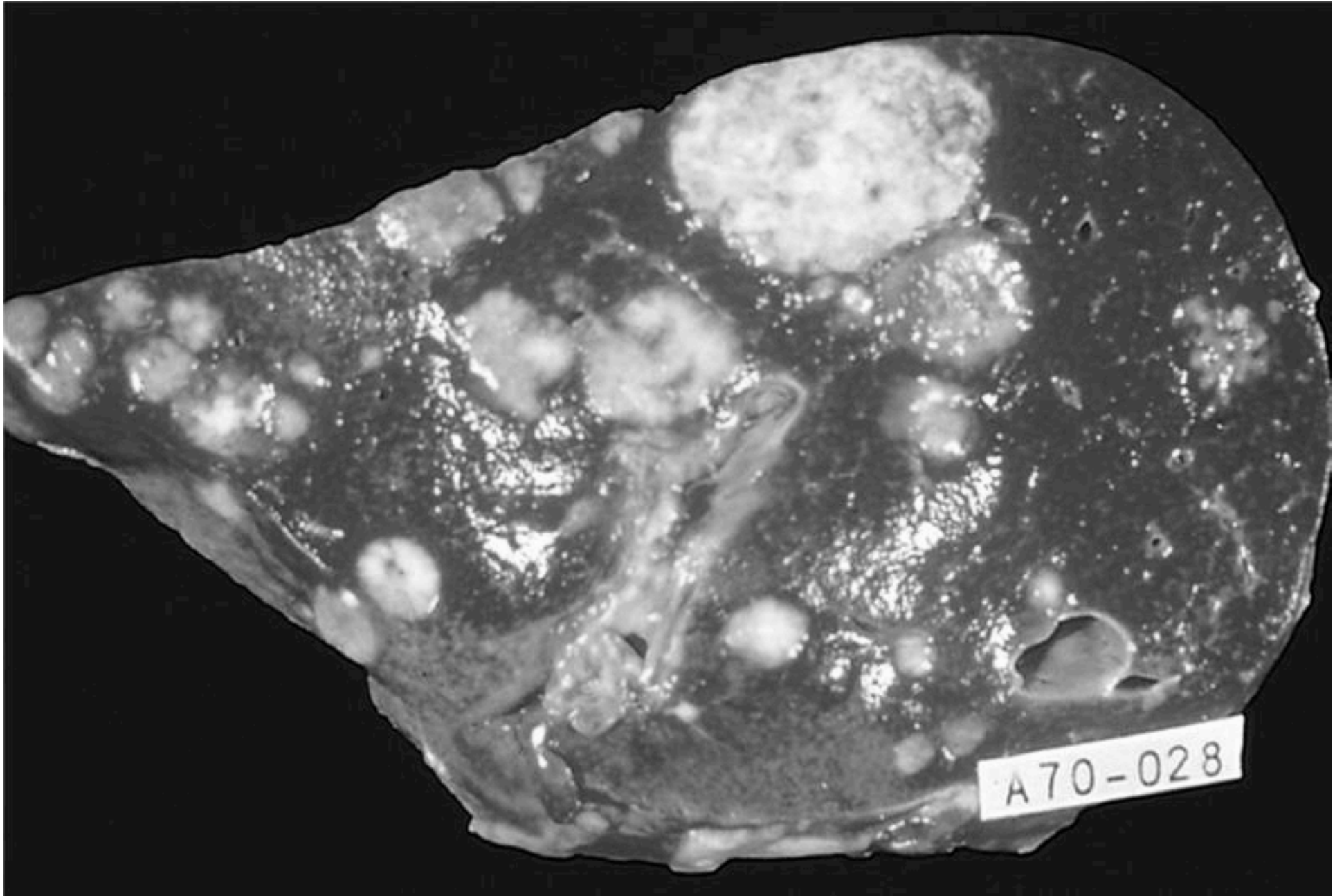


Invasive carcinoma



Metastasizing carcinoma





Liver with multiple metastases

# Metastasis

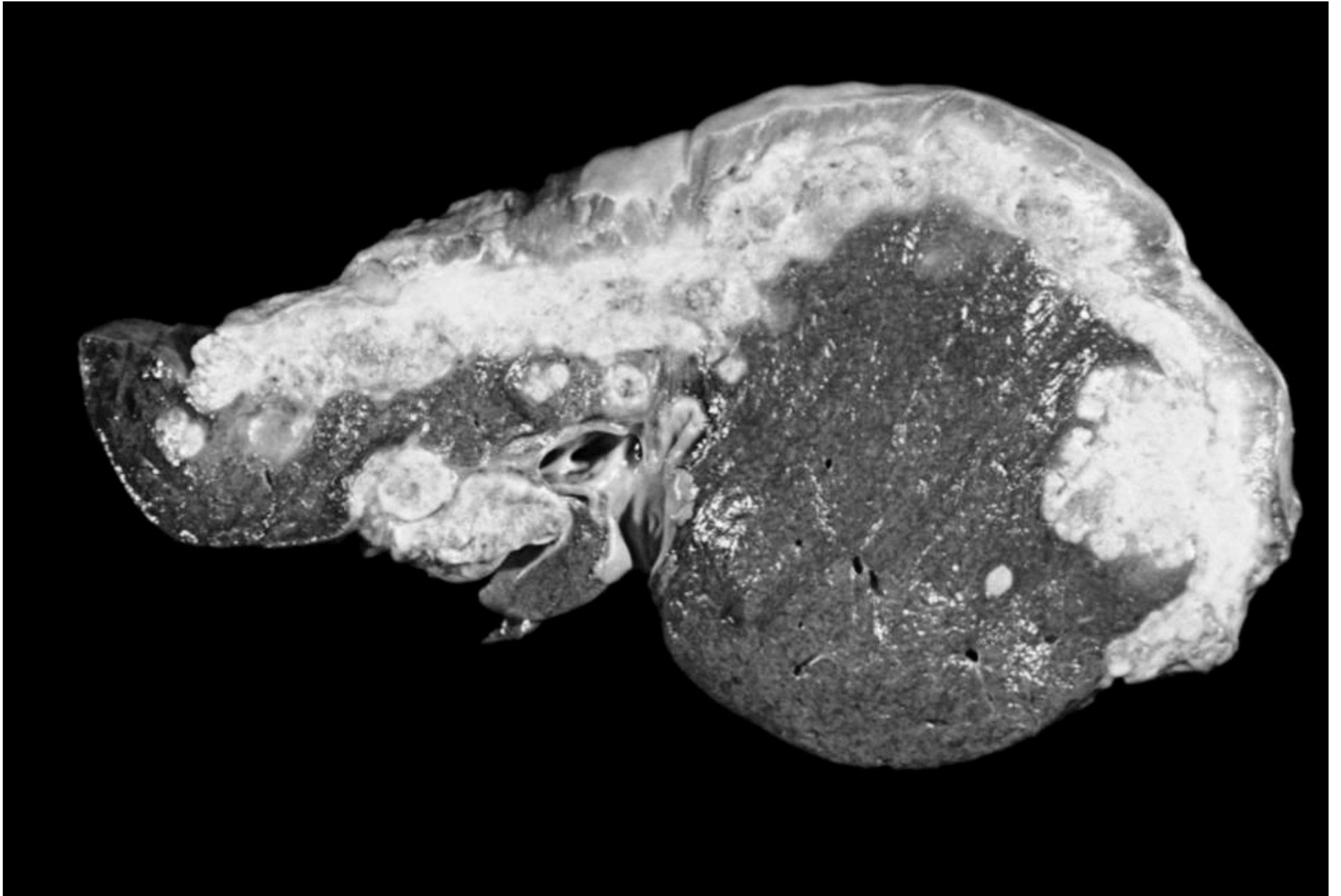
- Metastasis = development of secondary tumor implants in distant tissues
- Half of all patients with malignancies have mets at the time of diagnosis!!
- Metastasis depends on:
  - Type of tumor
  - Size of tumor
  - Degree of differentiation of tumor

# Three Ways Tumors Metastasize

- Seeding
- Lymphatic spread
- Hematogenous spread

# Three Ways Tumors Metastasize

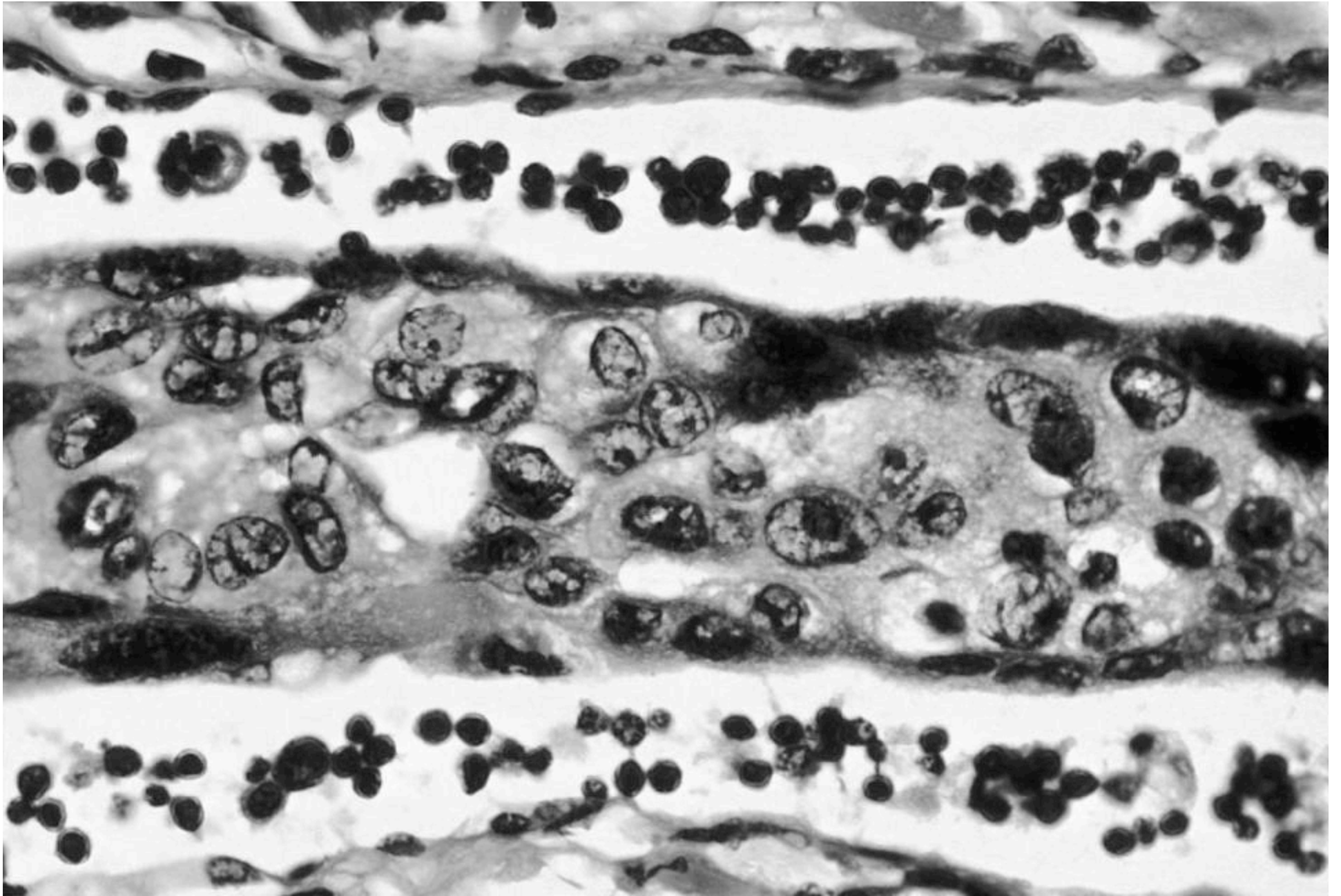
- Seeding
  - Tumor invades body cavity
  - Bits break off and implant on peritoneal surfaces
  - Ovarian cancer can spread easily this way



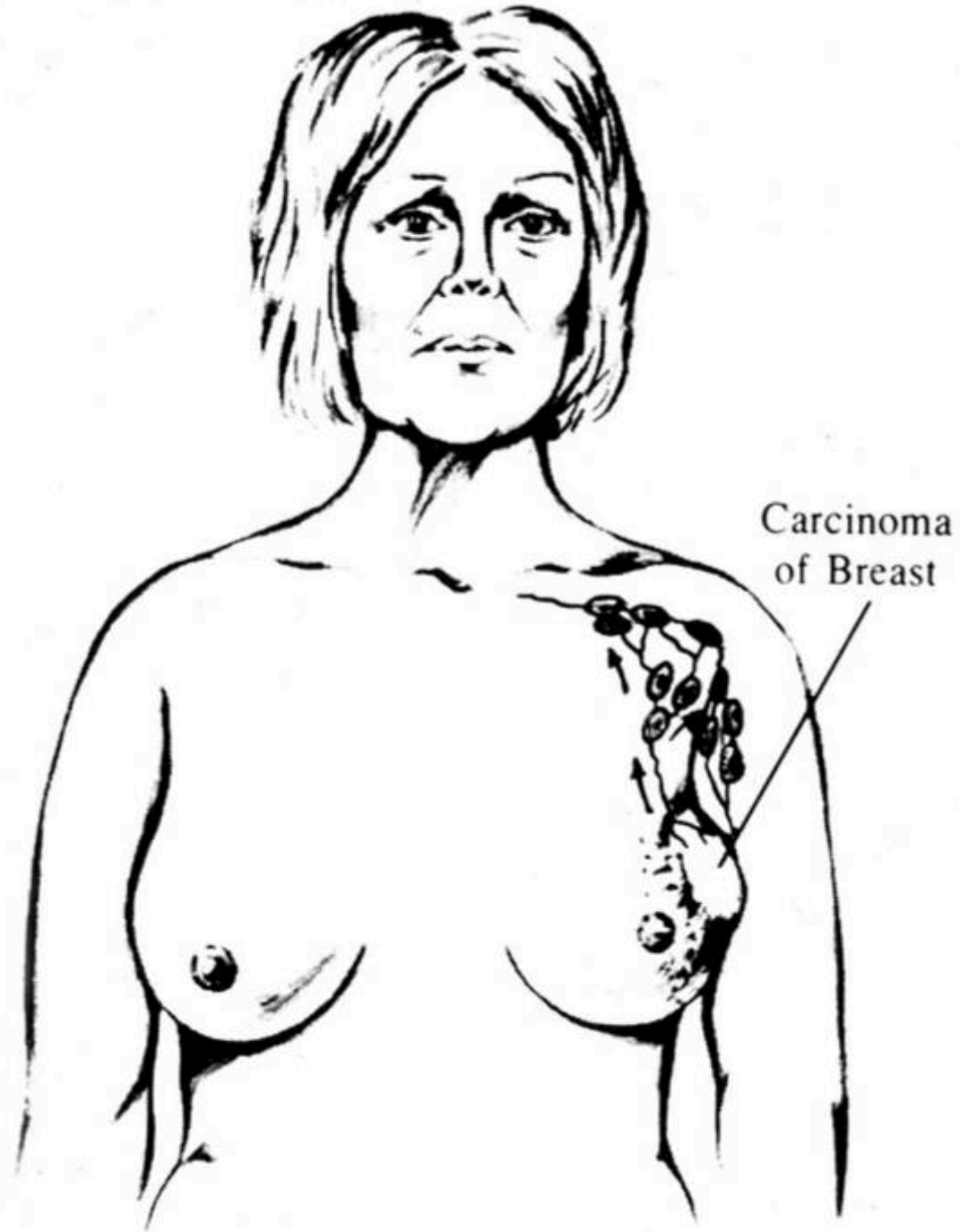
Liver seeded with metastatic ovarian carcinoma

# Three Ways Tumors Metastasize

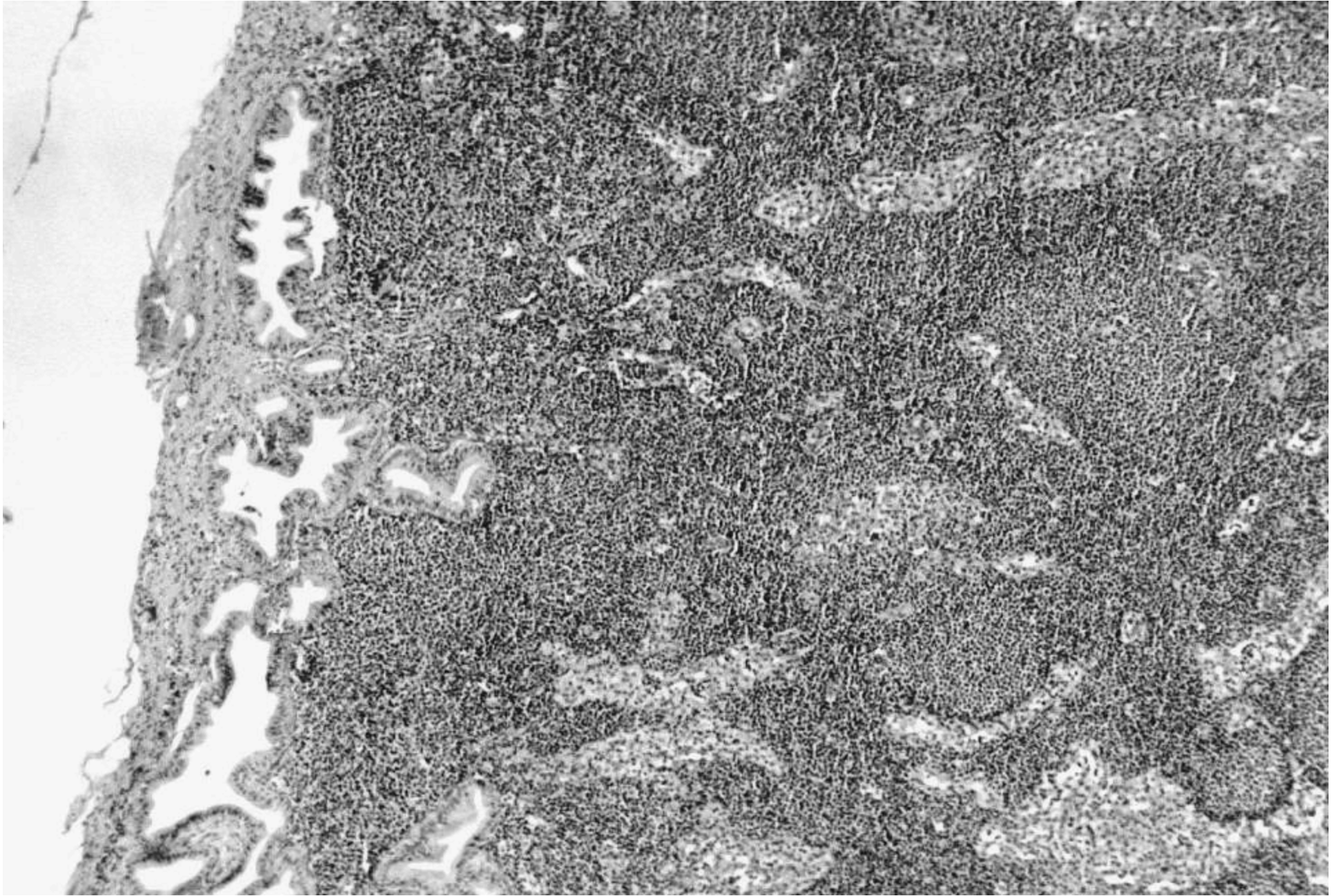
- Seeding
- Lymphatic spread
  - Tumor spreads to local lymph nodes
  - Sentinel lymph node first
  - Moves through thoracic duct
  - Empties into subclavian vein
  - Carcinomas like to spread this way



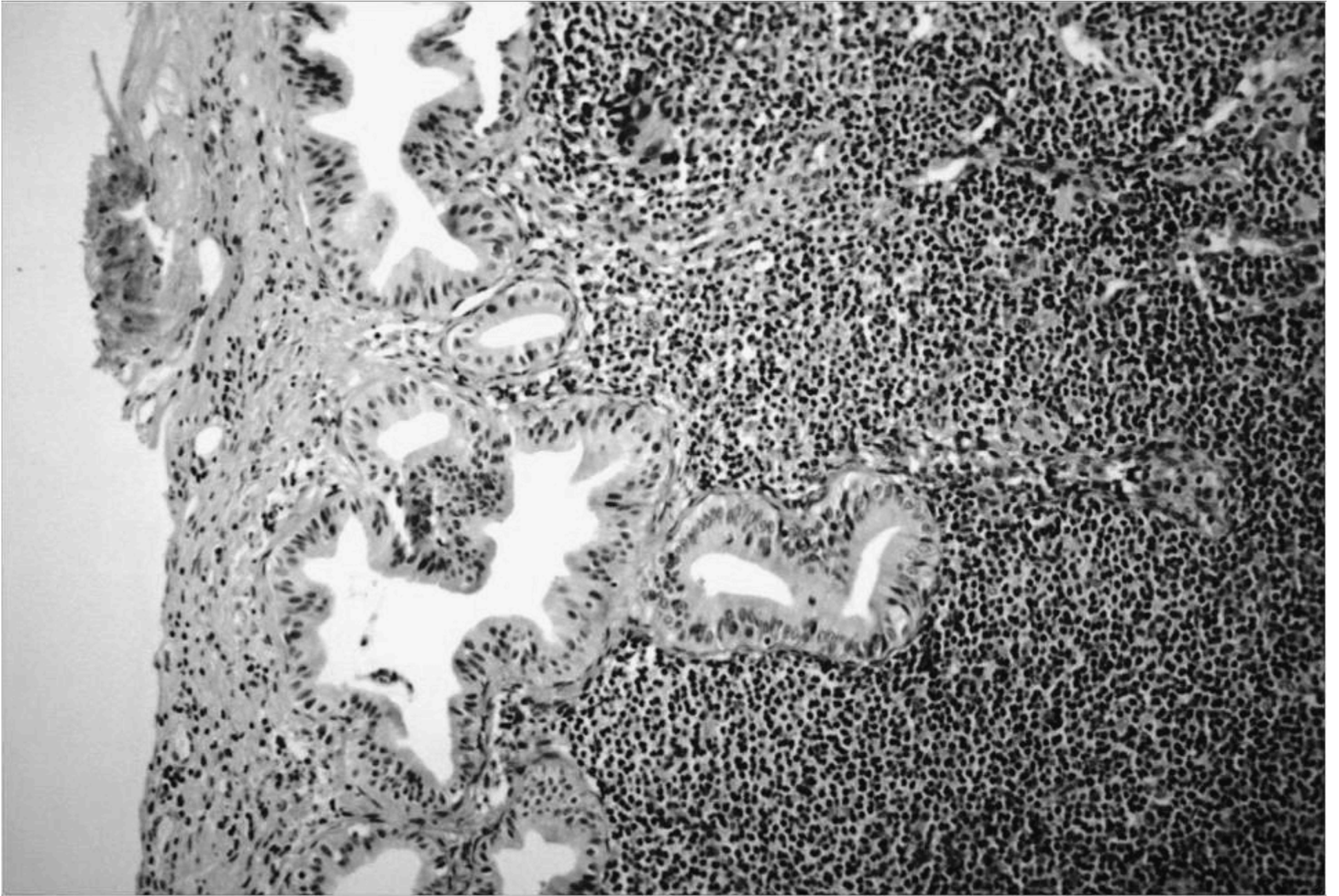
Tumor in lymphatic



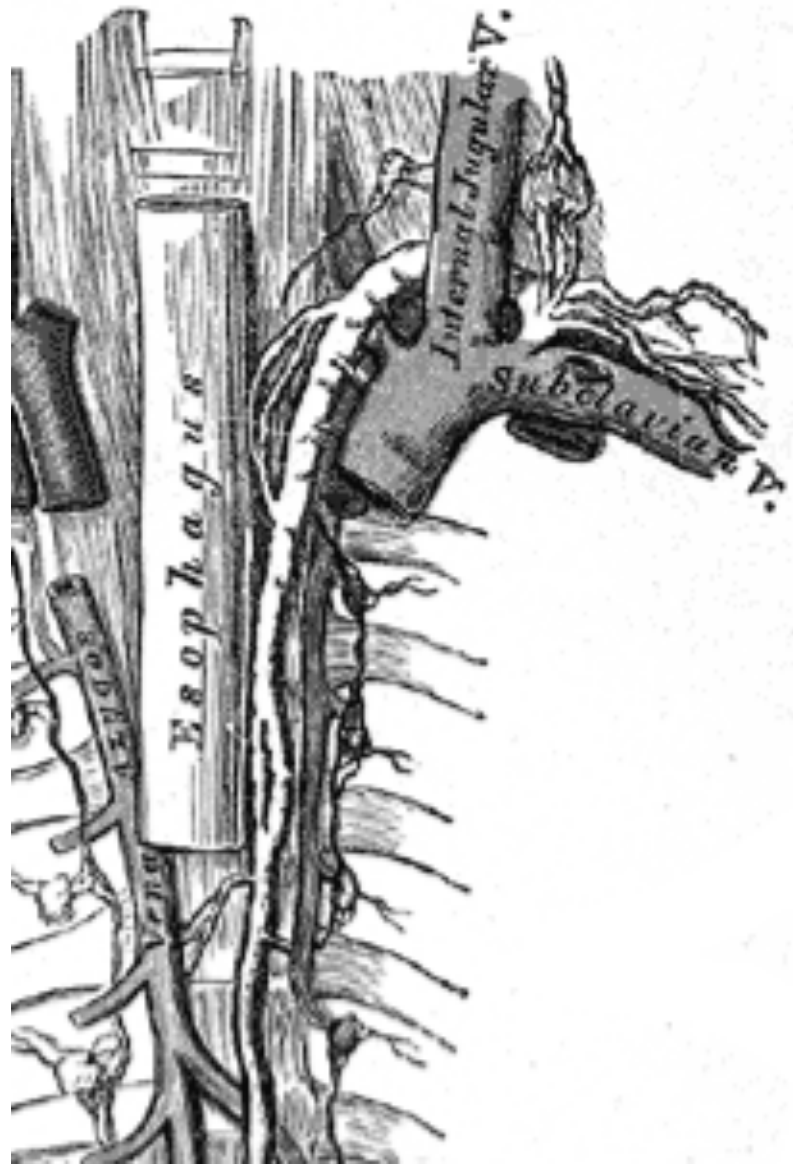
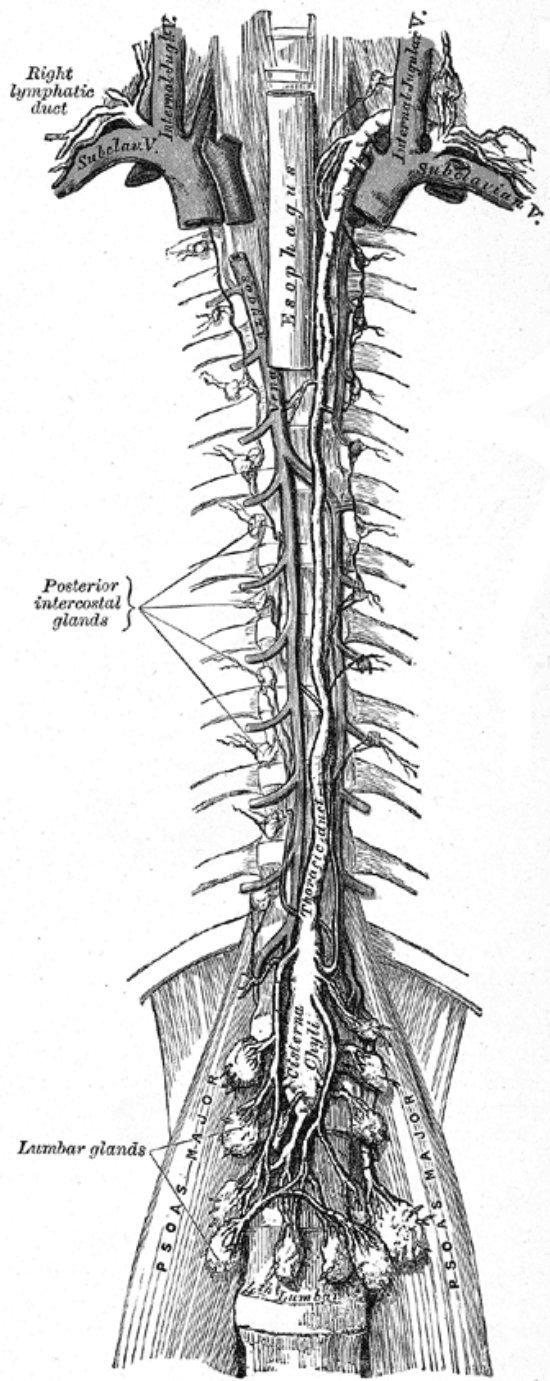




Tumor in lymph node



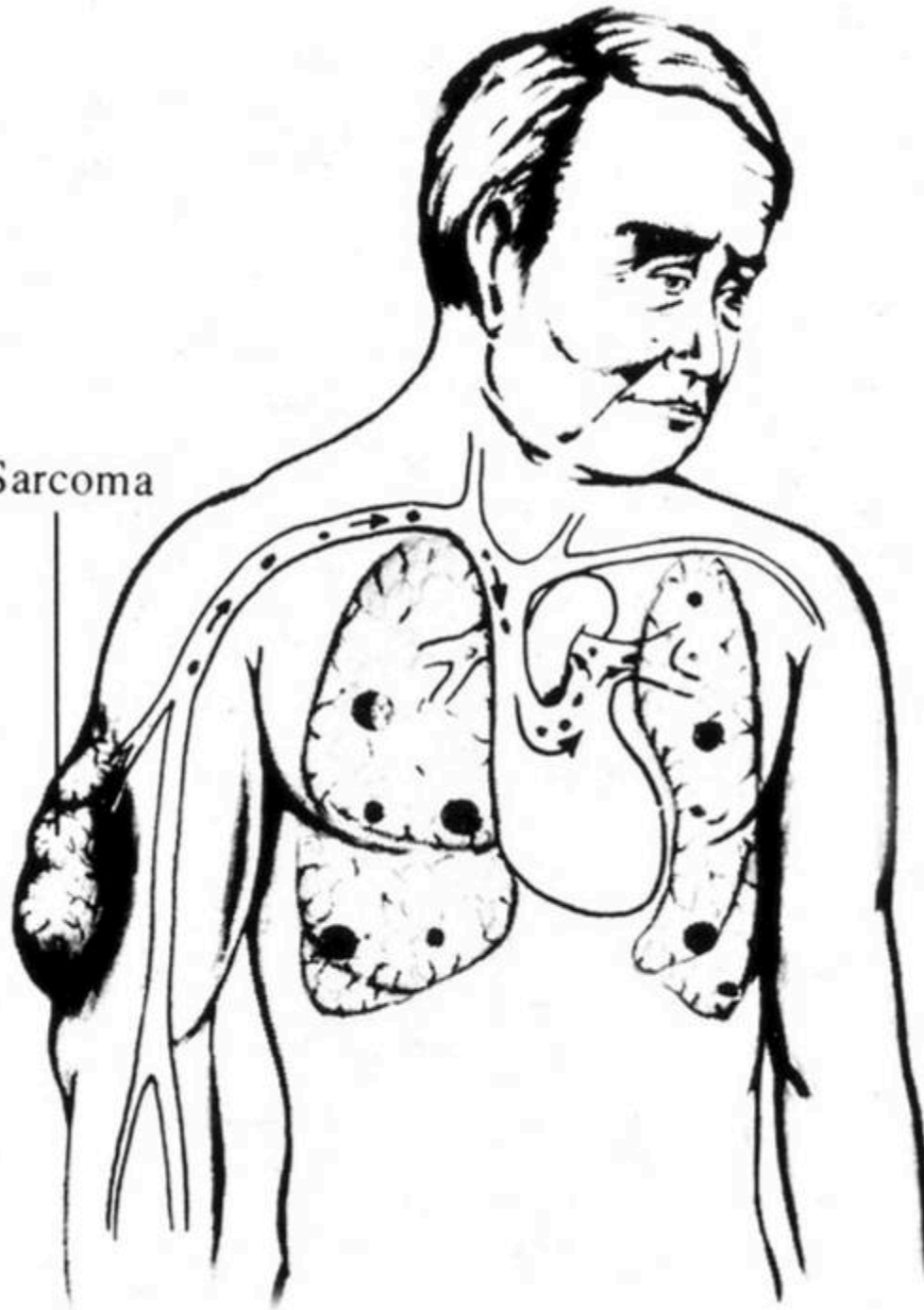
Tumor in lymph node

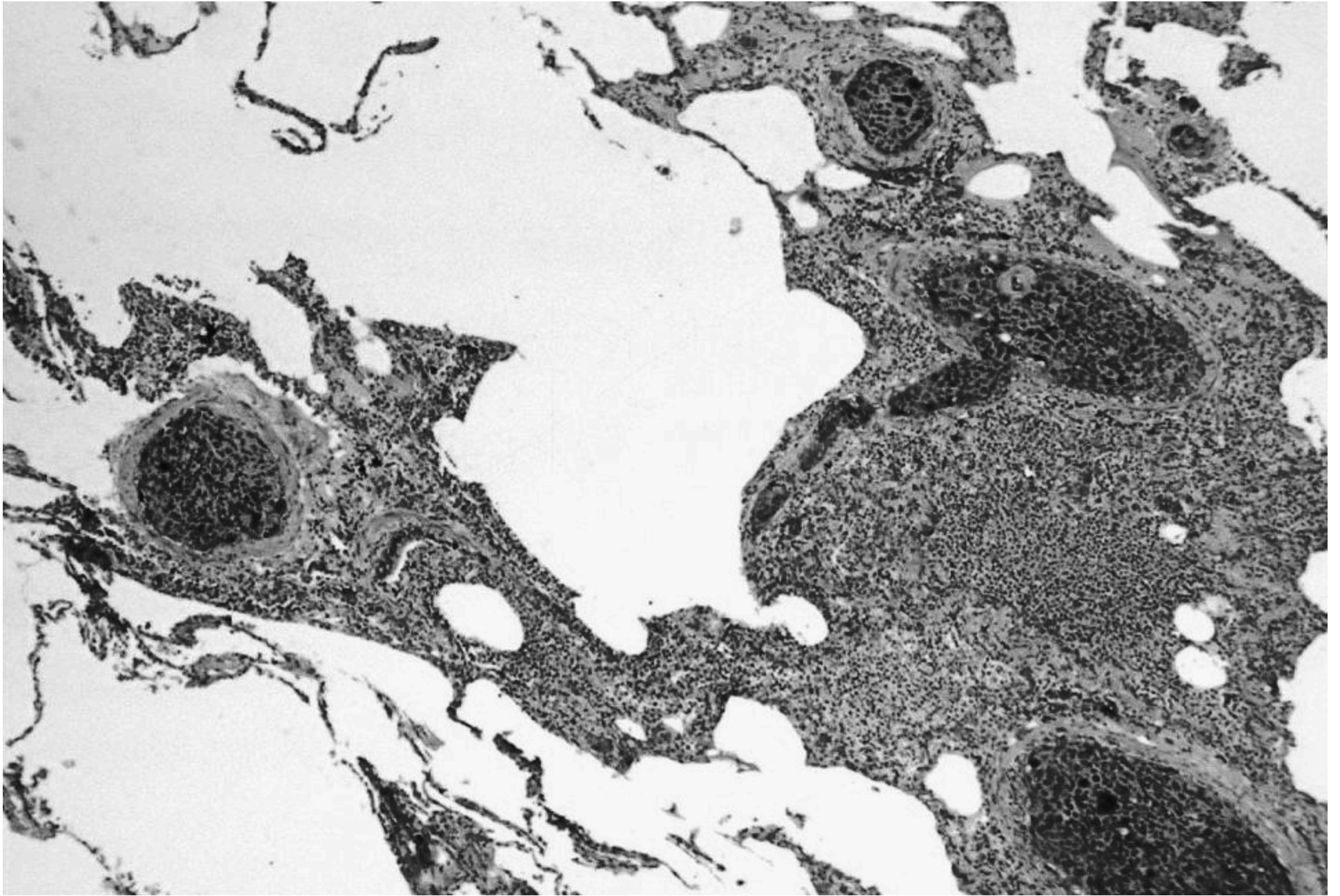


# Three Ways Tumors Metastasize

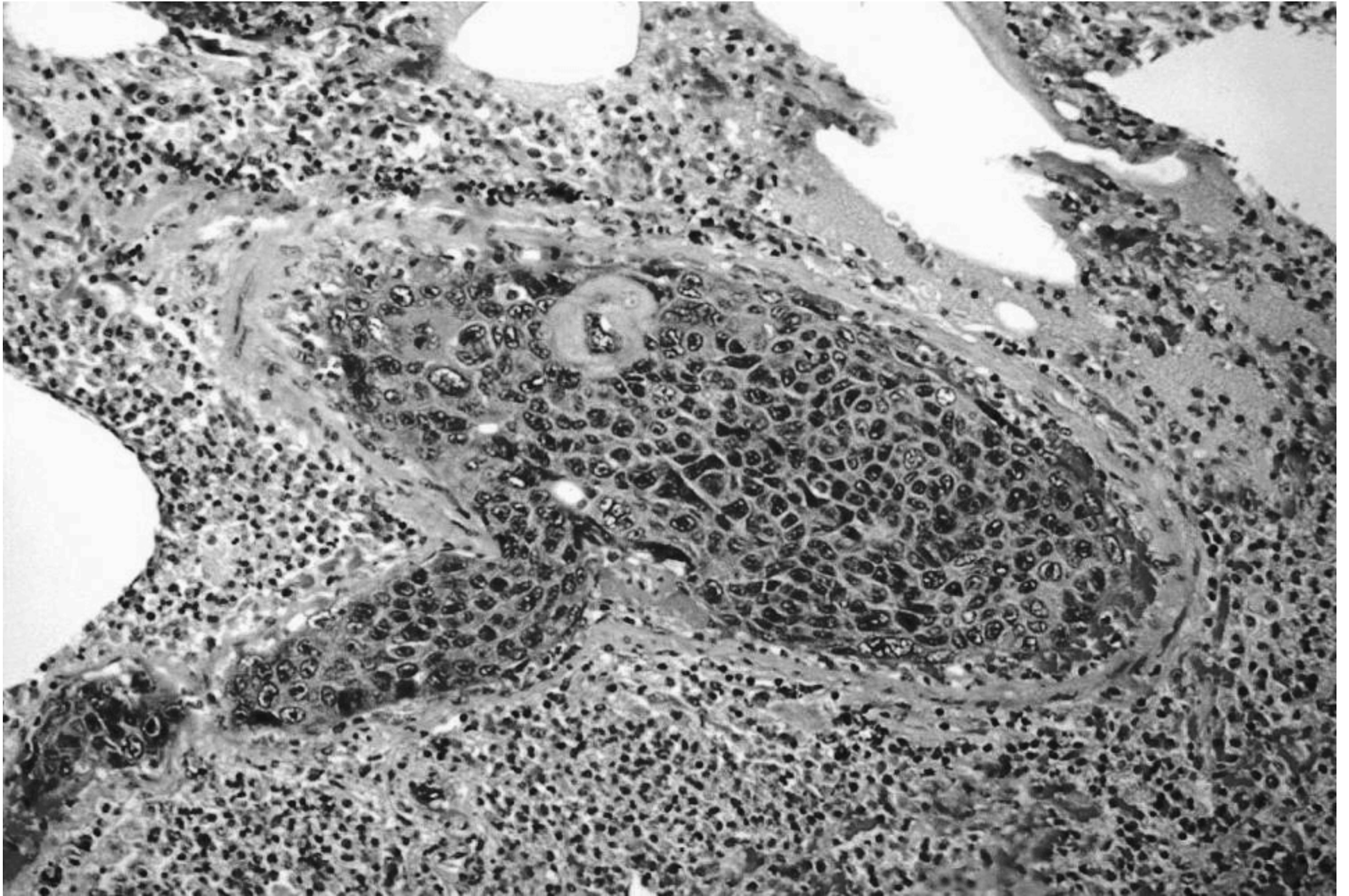
- Seeding
- Lymphatic spread
- Hematogenous spread
  - Veins are easier to invade than arteries
  - Liver and lungs are the most common metastatic destinations
  - Sarcomas like to spread this way (but so do carcinomas)

Sarcoma





Sarcoma metastatic to lung



Sarcoma metastatic to lung