Neoplasia II: Tumor Characteristics

Kristine Krafts, M.D.
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
• Tumor characteristics
  • Differentiation and anaplasia
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

- mild dysplasia
- moderate dysplasia
- severe dysplasia

\[ \rightarrow \text{carcinoma in situ} \]

Neoplastic cells

- well-differentiated
- moderately-differentiated
- poorly-differentiated
- anaplastic
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
Neoplasia Outline

• Tumor nomenclature
• Tumor characteristics
  • 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
Neoplasia Outline

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

- Tumor nomenclature
- Tumor characteristics
  - Differentiation and anaplasia
  - Rate of growth
  - Local invasion
  - Metastasis
Carcinoma in situ
Invasive carcinoma
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 metastatic to lung
Sarcoma metastatic to lung