Tumors

د.محمد محمود حبش

Definitions

Metaplasia is the reversible transformation of one type of terminally differentiated cell into another fully differentiated cell type.

Dysplasia is a potentially premalignant condition characterized by increased cell growth, atypical morphology, and altered differentiation.

Neoplasia is autonomous abnormal growth of cells that persists after the initiating stimulus has been removed.

Tumour or neoplasm is a lesion resulting from neoplasia

Metaplasia

This represents an adaptive response of a tissue to environmental stress. It is mediated by changes in expression of genes involved in cellular differentiation.

It does not progress to malignancy. However, if the environmental changes persist dysplasia may result and progress to malignancy.

Examples of metaplasia:

- Change from ciliated to squamous cells in the respiratory epithelium of the trachea and bronchi in smokers;
- Change from squamous to columnar cells in the oesophageal epithelium of patients with gastro-oesophageal reflux disease.

Dysplasia

This is a potentially premalignant condition. May be a response to chronic inflammation or exposure to carcinogens. Early forms may be reversible: severe dysplasia has a high risk of progression to malignancy e.g.

- Dysplasia arising in colonic epithelium due to chronic ulcerative colitis;
- Squamous dysplasia in the bronchi of smokers.

Classification of tumours

Use this classification to give a differential diagnosis for any neoplasm.

Tissue of origin. Organ and tissue type

Behaviour: benign or malignant.

Primary or secondary.

Benign tumours

Slow growing; usually encapsulated; do not metastasize; do not recur if completely excised; rarely endanger life.

Effects are due to size and site.

Histology: well differentiated; low mitotic rate; resemble tissue of origin.

Malignant tumours

These expand and infiltrate locally; encapsulation is rare; metastasize to other organs via blood, lymphatics, or body spaces; endanger life if untreated.

Histology: varying degrees of differentiation from tissue of origin; pleomorphic (variable cell shapes); high mitotic rate.

Invasion

Invasion is the most important single criterion for malignancy, and is also responsible for clinical signs and prognosis, as well as dictating surgical management. *Factors that enable tumours to invade tissues include*:

- increased cellular motility;
- loss of contact inhibition of migration and growth;
- secretion of proteolytic enzymes such as collagenase, which weakens normal connective tissue bonds;
- Decreased cellular adhesion.

Metastasis

It is the process by which malignant tumours spread from their site of origin (primary tumour) to form secondary tumours at distant sites. Carcinomatosis denotes extensive metastatic disease. The routes of metastasis are as follows.

- Haematogenous: via the blood stream.
  - Five tumours-breast, bronchus, kidney, thyroid, prostate-classically metastasize via haematogenous spread to bone.
  - Lung, liver, and brain are common sites for secondaries.
- Lymphatics to local, regional, and systemic nodes.
- Transcoelomic: across pleural, pericardial, and peritoneal cavities.
- Implantation: during surgery or along biopsy tracks.

Table Structural classification of tumours

Tissue of origin	Tumour types
Epithelium	**Benign:** papilloma, adenoma (glandular epithelium)
	Malignant: carcinoma (adenocarcinoma, squamous cell carcinoma: indicate cell types)
Connective tissue	**Benign:** fibroma (fibrous tissue), lipoma (fat), chondroma (cartilage), osteoma (bone), leiomyoma (smooth muscle), rhabdomyoma (striated muscle)
	Malignant: sarcoma. E.g. fibrosarcoma, osteosarcoma, etc. (if well differentiated). Spindle cell sarcoma, etc. (if poorly differentiated)

Neural tissue	These arise from nerve cells, nerve sheaths, and supporting tissues, e.g. astrocytoma, medulloblastoma, neurilemmoma, neuroma, etc.
Haemopoietic	The leukaemias, Hodgkin's disease, multiple myeloma, lymphosarcoma, reticulosarcoma
Melanocytes	Melanoma
Mixed origins	E.g. fibroadenoma, nephroblastoma, teratoma (all 3 germ layers), choriocarcinoma
Developmental blastomas	E.g. neuroblastoma (adrenal medulla), nephroblastoma (kidney), retinoblastoma (eye)

Carcinogenesis

Carcinogenesis is the process that results in malignant neoplasm formation. Usually more than one carcinogen is necessary to produce a tumour, a process that may occur in several steps: ***multistep hypothesis:***

- **Initiators produce a permanent change in the cells but do not themselves cause cancer, e.g. ionizing radiation. This change may be in the form of gene mutation.**
- **Promoters stimulate clonal proliferation of initiated cells, e.g. dietary factors and hormones. They are not mutagenic.**

- **Latency is the time between exposure to carcinogen and clinical recognition of tumour due to:**
  - o Time taken for clonal proliferation to produce a significant cell mass;
  - o Time taken for exposure to multiple necessary carcinogens.
- **Persistence is when clonal proliferation no longer requires the presence of initiators or promoters and the tumour cells exhibit autonomous growth.**

Tumour growth

Tumour doubling time depends on cell cycle time, growth function, and cell loss fraction. In tumours such as leukaemias the doubling time remains remarkably constant: the cell mass increases proportionally with time. This is exponential growth. In solid tumours doubling time slows as size increases. This is referred to as Gompertzian growth.

Thank you