Pathology

lecture 1

prof. hab. n. med. Andrzej Marszalek

Pathology lecture 1

• Adaptive changes
• Atrophy
• Hyperplasia
• Hypertrophy
• Necrosis
• Apoptosis

Pathomorphology

pathologic anatomy

pathology

• autopsies
• cytology
• aspiration cytology (BAC)
• biopsies (core, needle, surgical)
• surgical pathology

autopsy

• "Dead men tell no tales"
• Dead men „speak” eloquently when interrogated appropriately. So do dead women and dead babies.
pathology

- etiology
- pathogenesis (pathomechanism)
- tissue changes → morphology
- functional changes → clinic

Virchow 2020 (50)

<table>
<thead>
<tr>
<th>gross</th>
<th>+</th>
<th>±</th>
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<tr>
<td>micro</td>
<td>±</td>
<td>+</td>
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<tr>
<td>inc</td>
<td>+</td>
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<td>genetics</td>
<td>+</td>
<td>+ (?)</td>
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cell injury and cell death

apoptosis

- Adaptive changes:
  - hyperthropy
  - hyperplasia
  - atrophy
  - metaplasia

hypertrophy

an increase in size of cells and with such change, an increase in the size of the organ

a) hormonal response:
- growth of uterus during pregnancy

b) adaptive response:
- hypertrophy of the heart muscle
- hypertrophy of the striated skeletal muscle
**hyperplasia**

An increase in the number of cells in an organ or tissue, which may then have increased volume.

**hyperplasia**

- types of tissue
- 1) capable for DNA synthesis:
  - epidermis
  - intestinal epithelium
  - hepatocytes
  - fibroblasts
  - bone marrow
- 2) intermediate capacity:
  - bone tissue
  - cartilage tissue
  - smooth muscle cells
- 3) without capacity for hyperplasia:
  - nerve cells
  - cardiac and skeletal muscle

**atrophy**

- → shrinkage in the size of the cell by loss of cell substance. Atrophic cells may have diminished function, but they are not dead.

- causes of atrophy:
  - decreased workload
  - loss of innervation
  - diminished blood supply
  - inadequate nutrition
  - loss of hormone stimulation
  - aging

- protein synthesis/degradation rate → ↓↓
- autophagic vacuoles - residual bodies (e.g. lipofuscin granules)

**metaplasia**

- a reversible change in which one adult cell type (epithelial or mesenchymal) is replaced by another adult cell type.

- moreover the influence that predispose to such metaplasia, if persistent, may induce cancer transformation in metaplastic epithelium

**metaplasia**

- in epithelial tissues (one type e. replaced by another type of e.):
  - respiratory tract
  - urinary tract
  - gastrointestinal tract
  - squamo-collumnar junction of the cervix

- in mesenchymal tissues:
  - fibrous connective tissue → osteoblasts/chondroblasts
  - cartilage tissue → cartilage cells/osteoclasts
  - after irradiation
  - in tumors (e.g. leiomyomas, desmoid tumors, neurofibromas)

- myeloid metaplasia
  - proliferation of hematopoietic tissue in sites other than bone marrow → injection sites, liver, spleen (extramedullary hematopoiesis)

**metaplasia (examples)**

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Cell injury

- Depends on:
  - Type, time and the force of injurious factor,

- Effects depend on:
  - Type of cell and its metabolic status, regenerative abilities and genetic background

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### NECROSIS vs APOPTOSIS

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<thead>
<tr>
<th></th>
<th>NECROSIS</th>
<th>APOPTOSIS</th>
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<tbody>
<tr>
<td>Cell diameter</td>
<td>↑↑ (edema)</td>
<td>↓↓</td>
</tr>
<tr>
<td>Nucleus</td>
<td>pyknosis → karyorrhexis → karyolysis</td>
<td>fragmentation</td>
</tr>
<tr>
<td>Nuclear membrane</td>
<td>disrupted</td>
<td>continuous (changed structure)</td>
</tr>
<tr>
<td>Cytoplasm</td>
<td>„leakage”, lysis</td>
<td>no changes (apoptotic bodies)</td>
</tr>
<tr>
<td>Inflammatory reaction</td>
<td>often</td>
<td>Lack</td>
</tr>
<tr>
<td></td>
<td>always pathologic</td>
<td>often physiologic</td>
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APOPTOSIS

- Lack of growth factors
  - bcl-2, bcl-x, bax
- chemotherapy
  - p53, Bax, Bak
- Misfolded proteins
  - diseases: Alzheimer, Huntington, Parkinson, DM2
- Induction of TNF rec.
  - T lymphocytes elimination → mechanism Fas-FasL
- Apoptosis stimulated by cytotoxic lymphocytes T
  - perforin, granzymes

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APOPTOSIS

- diseases with deregulated apoptosis:
  - non-effective apoptosis
    - neoplasia, autoimmune diseases
  - increased apoptosis
    - neurodegenerative diseases,
      - ischemia,
      - elimination of cells infected by viruses