Histology, Epithelial Tissue

1. Tissues. Classification
2. General properties of basic tissues
3. Epithelial tissue – principal characteristics and functions
4. Classification of epithelium
5. Types of epithelia:
   ✓ covering epithelia – types
   ✓ glandular epithelia – types
Histology: (Gr. ἱστός, histos, tissue + logos, study)

- general histology
- special histology = microscopic anatomy of the organ systems
Tissues – classification

- **Marie François Xavier Bichat**, 1797; Fr. tissu = tissue
  1801 – 21 types of tissue
- **August Franz Josef Karl Mayer**, histology;
  1819 – 8 types of tissue
- **Franz von Leydig**, 1857
  - 4 basic types:
    - ✓ **Epithelial tissue**
    - ✓ **Connective tissue**
    - ✓ **Muscle tissue**
    - ✓ **Nervous tissue**

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Cells</th>
<th>Extracellular Matrix</th>
<th>Main Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nervous</td>
<td>Intertwining elongated processes</td>
<td>None</td>
<td>Transmission of nervous impulses</td>
</tr>
<tr>
<td>Epithelial</td>
<td>Aggregated polyhedral cells</td>
<td>Very small amount</td>
<td>Lining of surface or body cavities, glandular secretion</td>
</tr>
<tr>
<td>Muscle</td>
<td>Elongated contractile cells</td>
<td>Moderate amount</td>
<td>Movement</td>
</tr>
<tr>
<td>Connective</td>
<td>Several types of fixed and wandering cells</td>
<td>Abundant amount</td>
<td>Support and protection</td>
</tr>
</tbody>
</table>
Tissues – general properties

- **Regeneration:**
  - physiological – permanent and cyclic
  - reparative

- **Degeneration**

- **Hypertrophy** – increase in cell size
  (Gr. ὑπέρ, excess + τροφή, nourishment)

- **Hyperplasia** – increase in cell number
  (Gr. ὑπέρ, excess + πλέσειν, to form)

- **Atrophy** – wasting away of a part of the body:
  - numerical (myocardium)
  - volumetric

- **Aplasia** (Gr. a, not + πλέσειν, to form)

- **Metaplasia** (Gr. change in form):
  - physiological
  - pathological

- **Neoplasia** (Gr. new growth) = tumor degeneration
Epithelial tissue

Textus epithelialis:

- Gr. ἐπί, epi, upon + θηλή, thēlē, nipple
- Origin – from all three germ layers of the embryo
- The tissue that:
  - covers surfaces in the body – epidermis
  - lines cavities of hollow organs – epithelium
    - digestive system
    - respiratory system
    - urinary system
    - reproductive (genital) system
    - cardiovascular system
- Many glands are also formed from epithelial tissue (sweat and sebaceous glands, pancreas, liver) – parenchyma
Epithelial tissue – functions

- **Main functions:**
  - protection (barrier), transport and secretion

<table>
<thead>
<tr>
<th>Multilayered epithelia:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect against friction and injury</td>
</tr>
<tr>
<td>Barrier to water, disease some toxins, etc</td>
</tr>
<tr>
<td>Lower layers regenerate upper layers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Single layerd epithelia:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication/gateway</td>
</tr>
<tr>
<td>Important in regulated transport of cells/molecules</td>
</tr>
</tbody>
</table>
Epithelial tissue – characteristics

- **Common features:**
  - epithelial cells rest on a basement membrane
  - morphological and functional cell polarity – basal and free apical poles
  - avascular tissue – lacks blood vessels
  - rich innervation
  - limited intercellular space
  - high regenerative capacity
Main components:

- **Basal lamina, lamina basalis:** 50-100 nm
  - proteins: **type IV collagen**, (types XV and XVIII)
  - heparane sulfate proteoglycans: perlecan, agrin
  - glycoproteins: laminin, entactin (or nidogen)

- **Anchoring fibrils:**
  - type VII collagen

- **Reticular lamina, lamina reticularis:**
  - type III collagen

Major functions:

- elastic support
- semiconductive filter

Lamina basalis – 120-250 nm:
  - lamina densa – 60-120 nm
  - lamina rara (lucida) externa et interna – 40 nm

Lamina reticularis s. fibroreticularis – type III collagen
Intercellular junctions

- 3 types intercellular junctions:
  - **Barrier (impermeable) junctions:**
    - tight junction, *zonula occludens*
    - occluding strip, *fascia occludens*
    - occluding spot, *macula occludens*
  - **Adhering (anchoring) junctions:**
    - *punctum adhaerens*
    - belt desmosome, *zonula adhaerens*
    - spot desmosome, *macula adhaerens* (Gr. *desmos*, band + *soma*, body)
  - **Communicating junctions:**
    - gap junction, *nexus*
    - synapse

- Junctional complex
Epithelial tissue - classification

КАК се класифицира епитела?

В ЗАВИСИМОСТ ОТ БРОЯ НА СЛОЕВЕТЕ

ЕДИН СЛОЙ
- еднослоен
- няколко слоя ядра

ПОВЕЧЕ СЛОЕВЕ
- многослоен

привидно многослоен
Simple epithelium – classification

В ЗАВИСИМОСТ ОТ ФОРМАТА НА КЛЕТКИТЕ

Плоски
- плосък
- lumen

Кубични
- кубичен
- lumen

Призматични
- призматичен

Simple squamous  Simple cuboidal  Simple columnar

Prof. Dr. Nikolai Lazarov
Epithelial tissue – classification

Epithelial tissues

Simple (one cell thick)
- Squamous
- Cuboidal
- Columnar
- Ciliated
- Pseudostratified
  - Columnar
  - Cuboidal
  - Ciliated
  - Stratified
  - Transitional

Compound (more than one cell thick)
- Squamous
- Cuboidal
- Columnar
- Columnar ciliated

Keratinized
- Non-Keratinized

Classification of Epithelial Tissues

Shapes
- Squamous
- Cuboidal
- Columnar

Simple
- Simple squamous
- Simple cuboidal
- Simple columnar

Stratified
- Stratified squamous
Epithelial tissue – classification

- Covering epithelia:
  - simple
    - squamous
    - cuboidal
    - columnar
    - pseudostratified ciliated columnar
  - stratified
    - squamous nonkeratinized
    - squamous keratinized
    - columnar
    - transitional (of Henle)

- Glandular epithelia:
  - exocrine
  - endocrine
Simple squamous epithelium

- Epithelium that lines blood and lymph vessels (endothelium, vasotheselium)
  - squamous in shape cells
  - a prominent, protruding nucleus
  - covering and metabolic functions

- Epithelium that lines certain body cavities, such as the pleural and peritoneal cavities (mesothelium)
Simple cuboidal epithelium

- covering:
  - ducts of the exocrine glands
  - ovary
- absorption:
  - walls of renal tubules
- secretion:
  - thyroid gland (follicles)
Simple columnar epithelium

- covering:
  - ducts of the exocrine glands
- absorption:
  - intestinal villi
- secretion:
  - stomach
  - large intestine
  - uterus
- ciliated:
  - Fallopian tubes
  - distal bronchi
Simple columnar epithelium

- types of cells:
  - absorptive cells, enterocytes (90%) – 30 μm
  - mucous (goblet) cells
  - basal (stem) cells
Pseudostratified columnar epithelium

- covering:
  - large ducts of the exocrine glands
- ciliated:
  - upper respiratory tract
  - epididymis
Transitional epithelium

- **Uroepithelium (urothelium):**
  - lining of renal calyces
  - urinary tract – ureters & bladder

- The form of the cells changes according to the degree of distention of the organ:
  - five or six cells in thickness
  - small basal cells
  - larger pear-shaped cells in the middle layers
  - superficial cells are rounded and frequently binucleate
Skin (epidermis):
- covers dry surfaces
- most superficial cells involute and are transformed into dead scales of protein (keratin) without discernible nuclei
- 5 layers of keratinocytes:
  - *stratum basale*
  - *stratum spinosum*
  - *stratum granulosum*
  - *stratum lucidum*
  - *stratum corneum* – keratin
- Mucous epithelium – covers wet surfaces:
  - oral cavity
  - oropharynx
  - esophagus
  - anal canal
  - vagina
- Metaplasia
- Corneal epithelium
- Bilayered cuboidal epithelium:
  - ducts of the sweat glands

- Stratified columnar epithelium:
  - rare – only in small areas
  - large ducts
    - of salivary glands
  - part of the urethra
  - ocular conjunctiva
- **Exocrine glands**  
  (Gr. *exo*, outside, + *krinein*, to separate):  
  - retain their connection with the surface epithelium  
  - tubular ducts  

- **Endocrine glands**  
  (Gr. *endon*, within, + *krinein*)  
  - connection with the surface is lost during development  
  - ductless
Exocrine glands

- General composition:
  - secretory portion
  - ducts

- Some exocrine glands:
  - salivary glands
  - exocrine pancreas
  - prostate
  - sebaceous and sweat glands
  - mammary glands etc.
Many ways of classifying:
- structure
- product secreted
- method of secretion

Structural types:
- simple (unbranched)
  - tubular
  - acinar
- compound (branched)
  - tubular
  - acinar (alveolar)
  - tubuloalveolar
Exocrine glands – types

- Exocrine glands - product secreted:
  - serous (*glandula serosa*)
  - mucous (*glandula mucosa*)
  - mixed (*glandula seromucosa*)
Serous glands

- Serous glands - examples:
  - parotid gland
  - lacrimal gland
  - exocrine pancreas

- Serous cells:
  - arranged in acini
  - produce a watery material, isotonic with blood plasma

Pancreas

- Apical region
- Eosinophilic granules
- Basal region
- Basophilic
Serous acinus

- a spherical mass of cells (serocytes):
  - with a small lumen in the center
  - polarized, pyramidal in shape cells
    - containing zymogen granules
    - secrete a fluid, rich in proteins (enzymes)
Mucous acinus

✓ a spherical mass of cells (mucocytes):
  ➢ with a larger lumen in the center
  ➢ cuboidal to columnar in shape cells, organized as tubules
    ● containing PAS-positive mucous material
    ● produce a viscous lubricating gel, rich in glycoproteins (mucins)

● Mucous glands - examples:
  ✓ labial and buccal glands
  ✓ esophageal and pyloric glands
  ✓ Brunner’s duodenal glands
Mixed acinus

- a spherical mass of cells:
  - with a large number of mucous cells forming tubules
  - relatively fewer serous cells, constituting serous demilunes (of Gianuzzi or Heidenhein)
  - myoepithelial cells surround each secretory portion

Mixed glands - examples:
- most salivary glands
- anterior lingual glands
Exocrine glands

- method of secretion:

✓ merocrine (eccrine) glands – exocytosis:
  Gr. *meros*, part + *krinein*, to separate
  ➢ most of the exocrine glands (eg, the pancreas)
  ➢ some endocrine glands

✓ apocrine glands: Gr. *apo*, away from + *krinein*
  ➢ aromatic glands
  ➢ large sweat glands
  ➢ mammary glands

✓ holocrine glands:
  Gr. *holos*, whole + *krinein*
  ➢ sebaceous glands in the skin
  ➢ tarsal (Meibomian) glands
Endocrine glands

- Endocrine glands – types:
  - endocrine cells may form anastomosing cords
    - anterior lobe of the pituitary
    - parathyroid gland
    - adrenal gland
  - endocrine cells may arrange as vesicles or follicles
    - thyroid gland
- secrete their products, hormones, directly into the blood
- ductless
Thank you ...