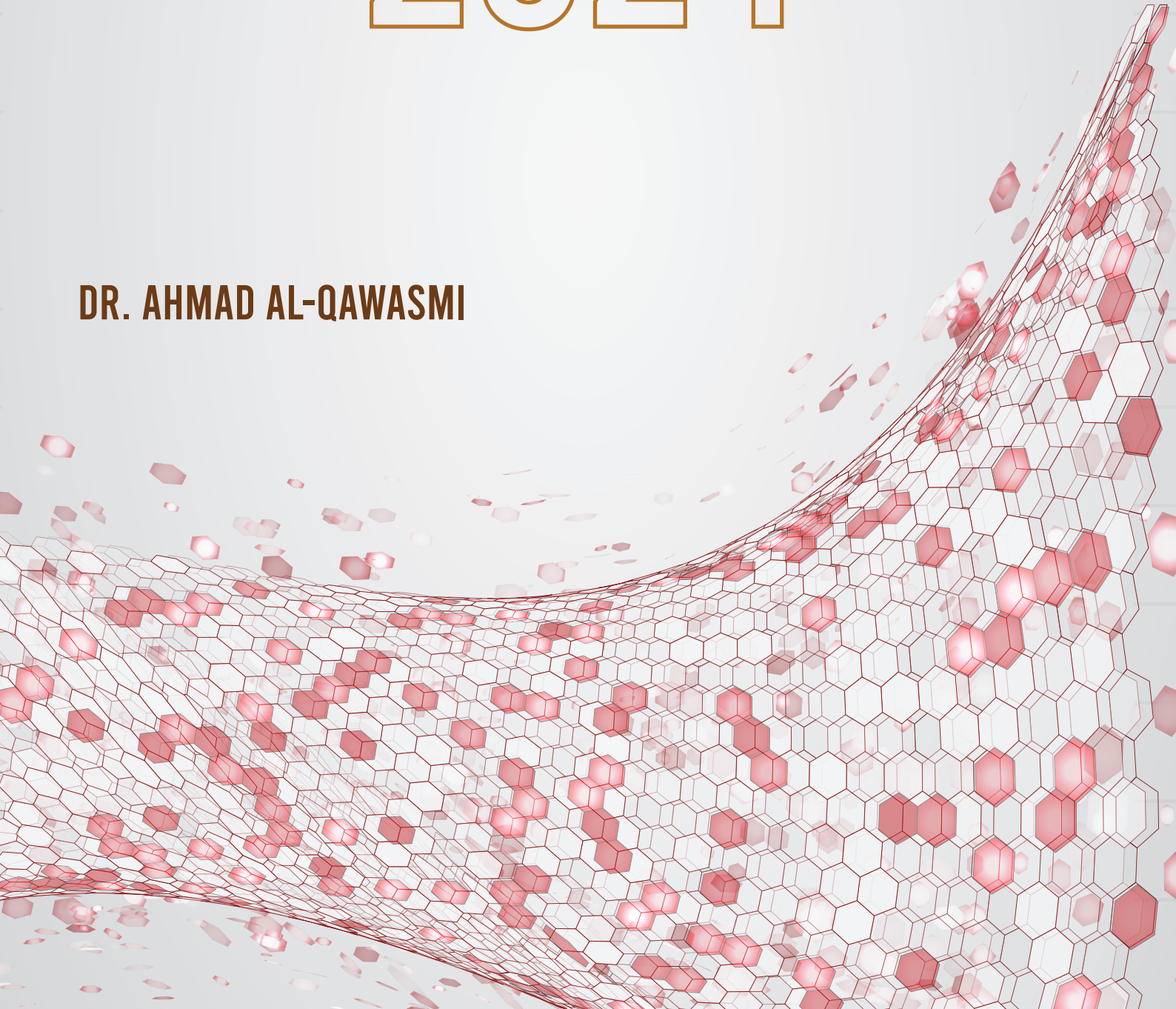


HISTOLOGY

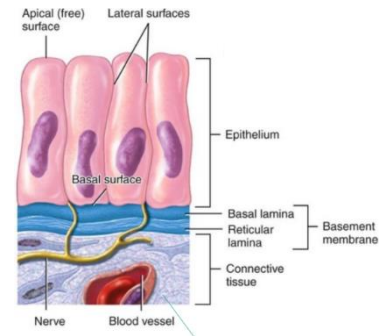
2024

DR. AHMAD AL-QAWASMI



❖ Epithelium

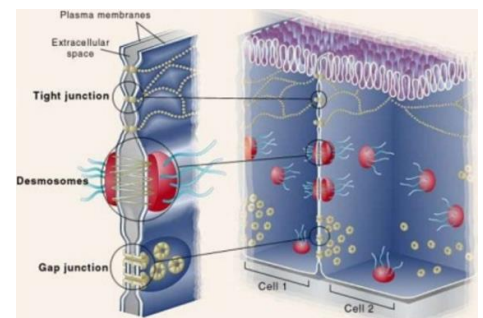
- Continuous sheets of cells adhering strongly to one another and to the underlying ECM, which *line internal* surfaces and *cover external* surfaces
- Epithelial tissue is *innervated* and *avascular*
 - It stands on and supported by an underlying connective tissue which provides oxygen and nutrients (blood supply) to the epithelium
 - Separated from the connective tissue by a **basement membrane**



- Functions of the epithelium:
 - *Protection* (covering, lining) like in the epidermis
 - *Secretion* (glandular tissue)
 - *Absorption* (intestines)
 - Detection of *sensation* (inner ear, taste buds)
 - *Contraction* (myoepithelial cells, glands)
- Embryogenesis of epithelium: epithelium arises from **all germinal layers**
 - **Ectoderm:** epidermis (stratified squamous keratinized)
 - **Mesoderm:** endothelium (blood vessels)
 - **Endoderm:** GIT tract (not all), lungs

- Epithelial cells are highly polarized:

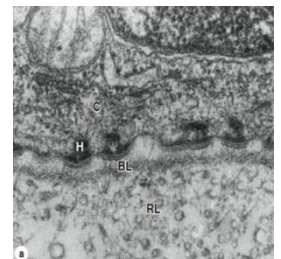
- **Apical surface:** faces the lumen or the external environment
 - ✓ Has microvilli, cilia, stereocilia
 - ✓ **Microvilli:** short extensions that increases the surface area aiding in the absorption
 - ✓ **Cilia:** longer and aids in mobility (with motor protein)
 - ✓ **Stereocilia:** found in the ear to provide hearing, equilibrium and absorption



- **Lateral surface:** faces the sides of adjacent cells
 - ✓ Tight junctions, desmosomes, gap junctions (intercellular junction)
- **Basal surface:** attaches to the basement membrane
 - ✓ Basement membrane, hemidesmosomes



- Epithelium is classified according to the **Cells' shape** (columnar, cuboidal and squamous)
 - Cell shape is determined by the nucleus shape (elliptic [oval], spherical or flattened)
- **Basement membrane:** Thin extracellular, felt-like sheet of macromolecules
 - A semipermeable filter for substances reaching epithelial cells from below
 - It is composed of *basal lamina* (produced by epithelium), *reticular lamina* (produced by CT)
- Molecules of basal lamina:
 - **Type IV collagen:** a two-dimensional network of evenly spaced subunits
 - **Laminin:** large glycoproteins that attach to integrins, and project through the network of collagen IV
 - **Nidogen (entactin) and perlecan:** protein and a proteoglycan, cross-link laminin to the collagen network and help determine the *porosity* of the basal lamina and the *size of molecules able to filter* through it



- Reticular lamina

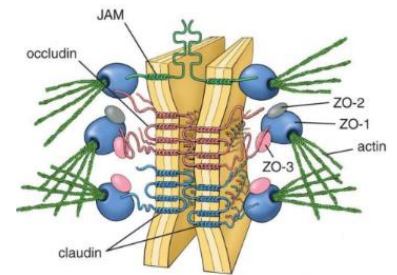
- Contain *reticular fibers (collagen type III)*
- Anchoring fibrils of *type VII collagen* link the basal lamina with the reticular fibers

❖ Junctional Complexes

- They are membrane-associated structures provide adhesion and communication between cells

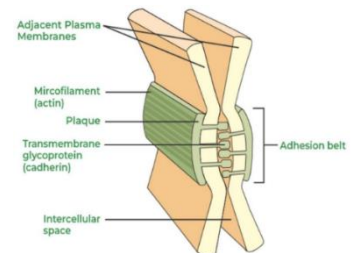
• **Tight Junction (Zonula occludens)**

- Also called *occluding junctions*
- They form a *seal between adjacent* cells, and they are the *most apical*
- Caused by the tight interactions between the transmembrane proteins *claudin, occludins* and *ZO proteins*
- The intercellular seal of tight junctions ensures that molecules crossing an epithelium in either direction do so through transcellular route not the paracellular one
- Defects in occludins may *compromise blood-brain-barrier* leading to *neurologic disorders*



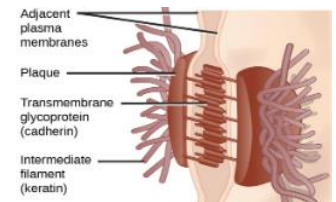
• **Adherent Junctions (Zonula Adherens)**

- *Encircle* the epithelial cell, usually below the tight junction
- Firmly *anchors* cells to neighboring ones
- Cell adhesion is mediated by *e-cadherin* (transmembrane glycoproteins) of each cell that bind each other in the *presence of Ca²⁺*
- At their cytoplasmic ends, cadherins bind *catenins* that link to actin filaments with actin-binding proteins
- The actin filaments linked to the adherens junctions form part of the “terminal web,” a cytoskeletal feature at the apical pole in many epithelial cells
- Link cytoskeleton of adjacent cells, and strengthen the tight junctions
- Defects in e-cadherins causes *epithelial cell tumor (carcinoma)* which can cause malignancy



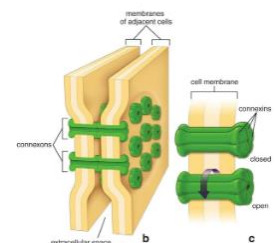
• **Desmosomes**

- *Disc-shaped* structures that are matched with identical structures at an adjacent cell surface
- Desmosomes contain larger members of the *cadherin* family called *desmogleins* and *desmocollins*
- The cytoplasmic ends of these transmembrane proteins bind a catenin-like protein which bind intermediate filament proteins rather than actins
- Autoimmunity against desmoglein causes skin disorder where cohesion of epidermal cells decreases



• **Gap Junctions (Nexus)**

- Mediate *intercellular communication*
- *Connexins* (transmembrane proteins) form hexameric complexes of proteins called *connexons*, each of which has a central hydrophilic pore about 1.5 nm
- Permit intercellular *exchange* of molecules with small molecules < 1.5 nm
- Mutations in connexin causes neuropathy and deafness



• **Hemidesmosomes**

- Located on the basal epithelial surface and attach cells to the basal lamina
- Resemble a half-desmosome ultra structurally, but unlike desmosomes the transmembrane proteins that indirectly link to cytokeratin intermediate filaments are *integrins* rather than cadherins
- The integrins of hemidesmosomes bind primarily to laminin molecules in the basal lamina and the anchor cytoskeleton to basal lamina
- *Epidermolysis bullosa* is a skin blistering disorder due to mutation in integrin-β4

