

Epithelial tissue : Epithelium is classified by both its cellular morphology and the number of cell layers. Based on morphology, epithelial cells can be either squamous (flat), cuboid (cube) or columnar (rectangular). Depending on the number of layers, epithelial tissue is classified into simple (single layered) or stratified (multi-layered)

A- Simple Epithelium

Simple epithelium can be subdivided according to the **shape and function** of its cells. *Squamous (thin cells), *cuboidal (cells roughly as thick as they are wide) or *columnar (cells taller than they are wide).

1-Simple Squamous epithelium

Simple squamous epithelium is composed of a single layer of tightly packed, thin, or low-profile polygonal cells. Squamous cells, for example, tend to have horizontal flattened, elliptical nuclei because of the thin flattened form of the cell. They form the lining of cavities such as the mouth, blood vessels, heart and lungs. Simple squamous epithelium lining the lumen surface of all types of blood vessels and lymphatic vessels is called an endothelium.

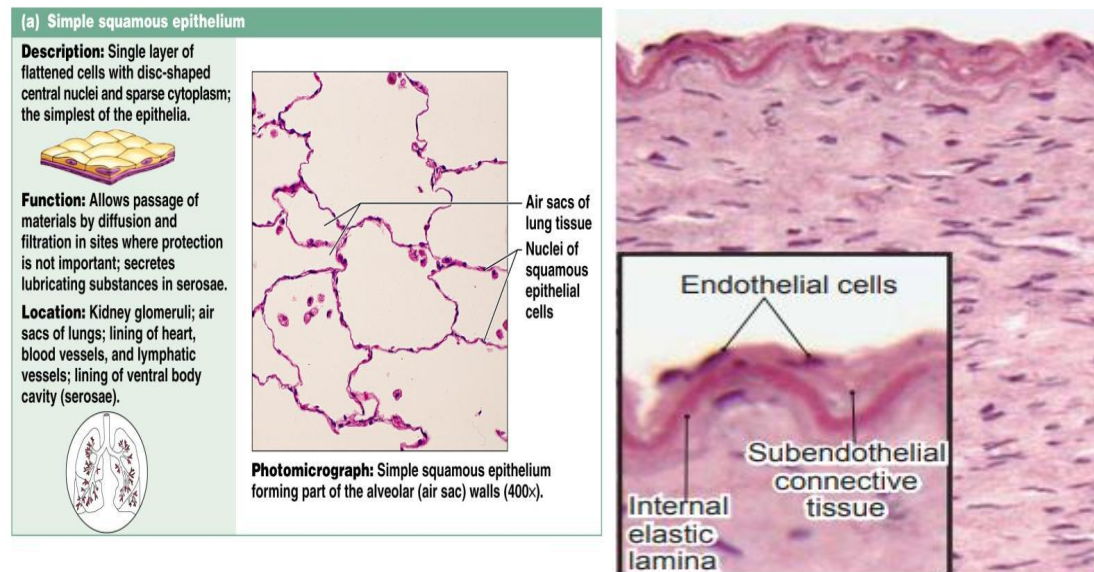


Fig.1 *Simple Squamous epithelium*

2- Simple cuboidal epithelium: A single layer of polygon-shaped cells constitutes simple cuboidal epithelium. When viewed in a section cut perpendicular to the surface, the cells present a square profile with a centrally placed round nucleus. Simple cuboidal epithelia make up the ducts of many glands of the body, form the covering of the ovary, and compose many kidney tubule.

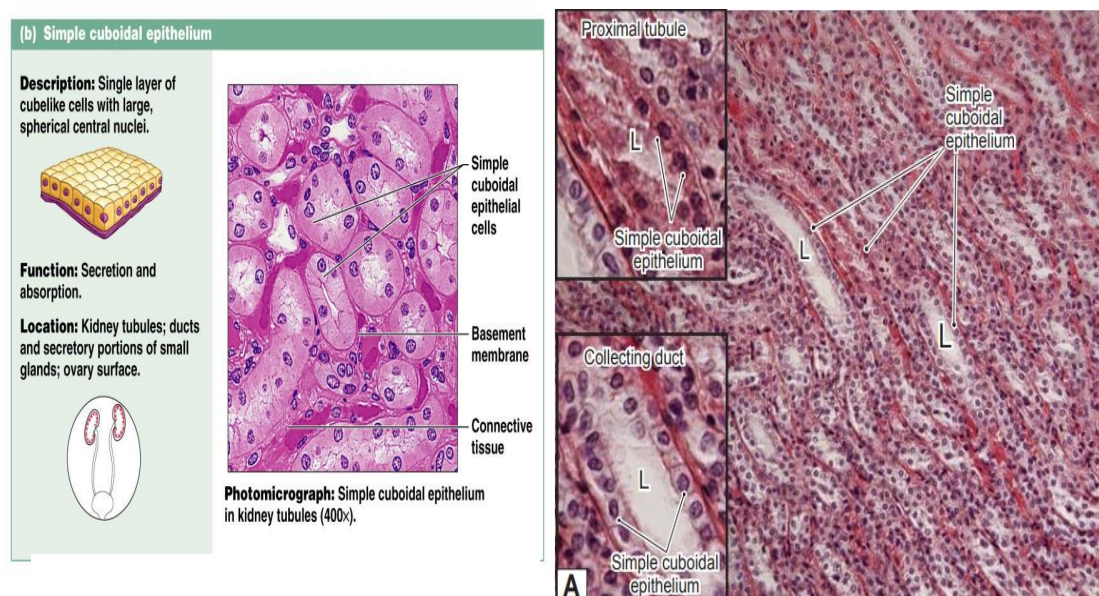
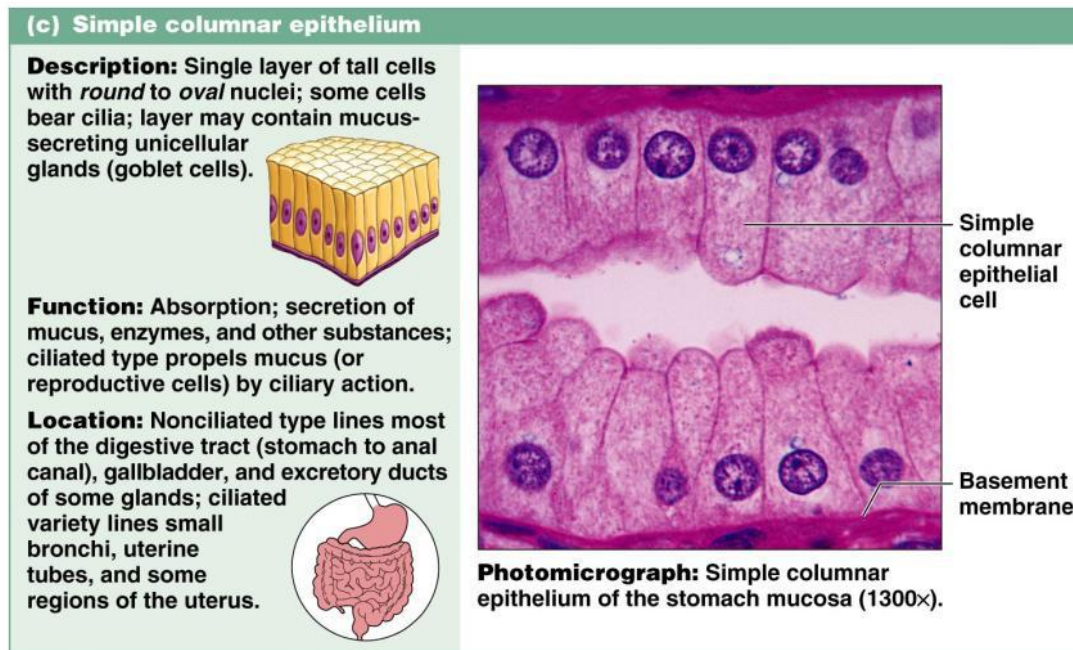


Fig.2. *Simple cuboidal epithelium*

3- Simple columnar epithelium

The cells of simple columnar epithelium appear tall, rectangular cells whose ovoid nuclei are usually located at the same level in the basal half of the cell. Simple columnar epithelium lines much of the digestive tract, gallbladder, and large ducts of glands. Simple columnar epithelium may exhibit a striated border, or microvilli (narrow, finger-like cytoplasmic processes), projecting from the apical surface of the cells. The simple columnar epithelium that lines the uterus, oviducts, and small bronchi is ciliated. In these organs, cilia (hairlike structures) project from the apical surface of the columnar cells into the lumen. Cells of simple columnar epithelia are taller than they are wide. Such cells are usually highly specialized for absorption, with microvilli, and often have interspersed secretory cells or ciliated cells. Such epithelial cells always have tight and adherent junctional complexes at their apical ends, but are often loosely associated in more basolateral areas. This allows for rapid transfer of absorbed material to the space between the cells rather than transport the full length of the cells. The additional cytoplasm in columnar cells allows additional mitochondria and other organelles needed for absorption and processing. The examples shown here are from a renal collecting duct **(a)**, the oviduct lining, with both secretory and ciliated cells **(b)**, and the lining of the gall bladder **(c)** (Fig.3).



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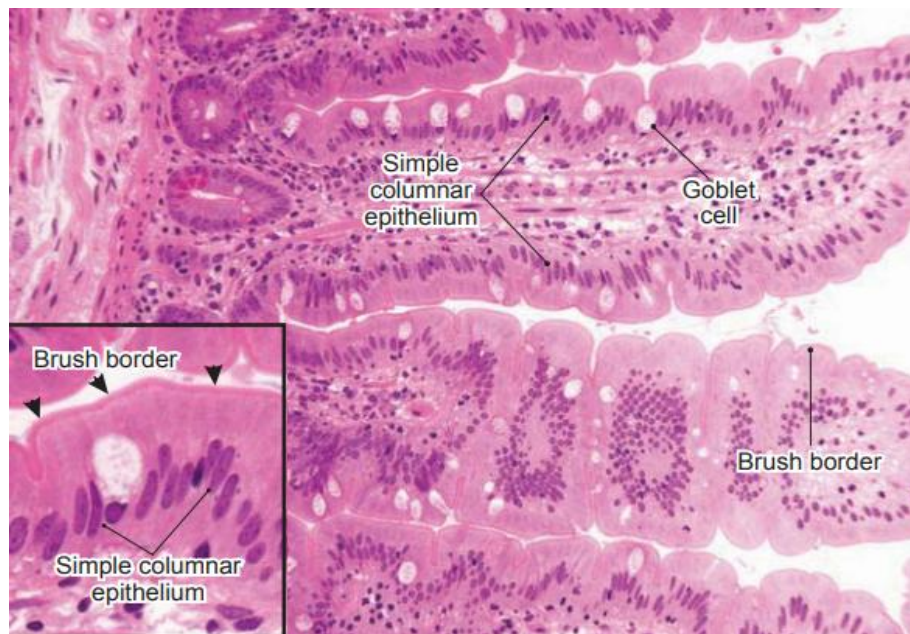
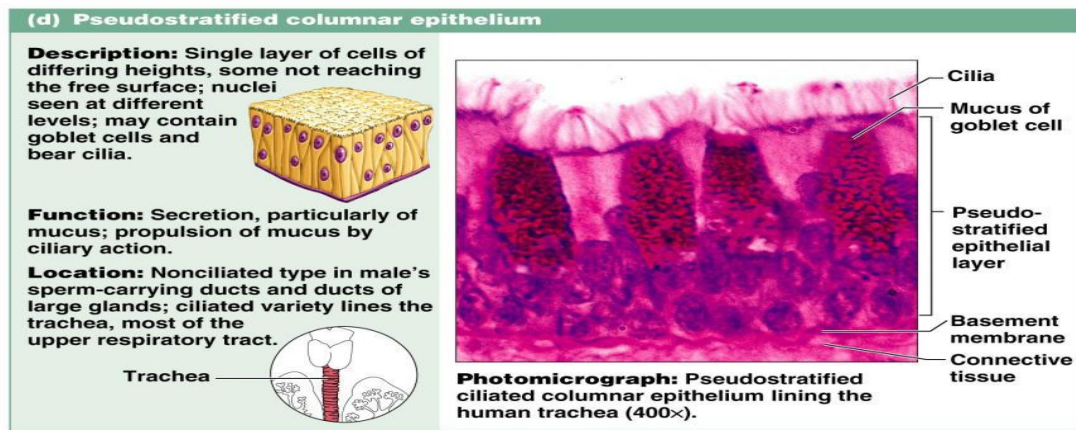


Fig.3. *Simple columnar epithelium*

4- Pseudostratified Columnar Epithelium: Cells of pseudostratified epithelia appear to be in layers, but the basal ends of the cells are all in contact with the basement membrane, which is often very thick in these epithelia. The best example of this epithelial type is the pseudostratified ciliated columnar epithelium of the upper respiratory tract, which



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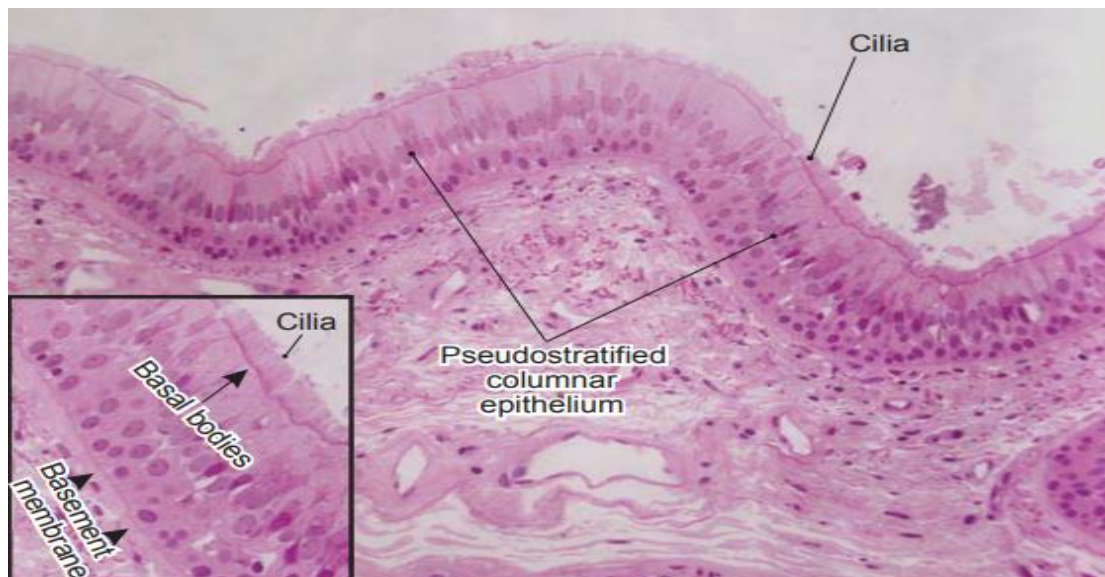
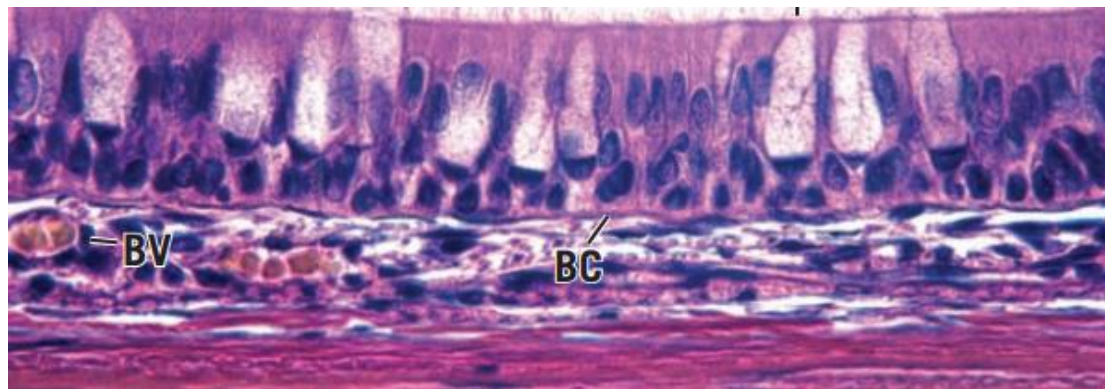


Fig.4. Pseudostratified Columnar Epithelium

B. Stratified Epithelium

1-Stratified squamous epithelia: have protective functions, protection against easy invasion of underlying tissue by microorganisms and protection against water loss. Stratified squamous epithelium that covers thin skin is similar to that of thick skin, although its superficial keratinized layer (stratum corneum) is much thinner than in thick skin. Keratinized stratified squamous epithelium is composed of several layers of cells. The superficial layers are formed by dead cells whose nuclei and cytoplasm have been replaced with keratin. Under the keratinized layer is the squamous cell layer; these cells are flat. The intermediate layers contain cells that are polyhedral. The cells close to the basement membrane are cuboidal in shape and are called basal cells; they are stem cells that are continuously dividing and migrating from the basal layer toward the surface as they differentiate. Stratified squamous epithelium (nonkeratinized) is usually wet on its surface and is found lining the mouth, oral pharynx, esophagus, true vocal cords, and vagina. Nonkeratinized stratified squamous epithelium is similar to keratinized squamous epithelium, but the flattened surface cells retain their nuclei, and there is no keratinization of these cells. (Fig.4).

Stratified Squamous Epithelium (Keratinized) Stratified Squamous Epithelium (Nonkeratinized)

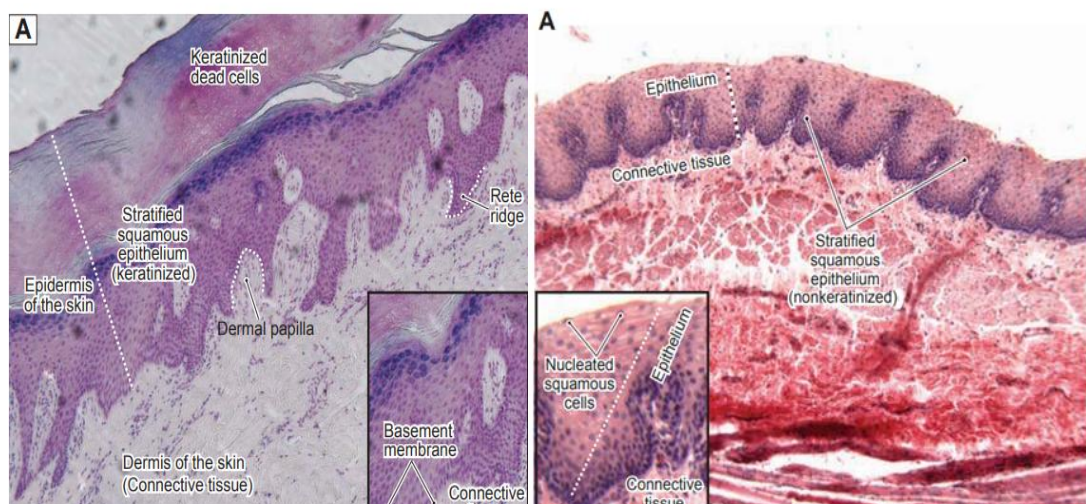
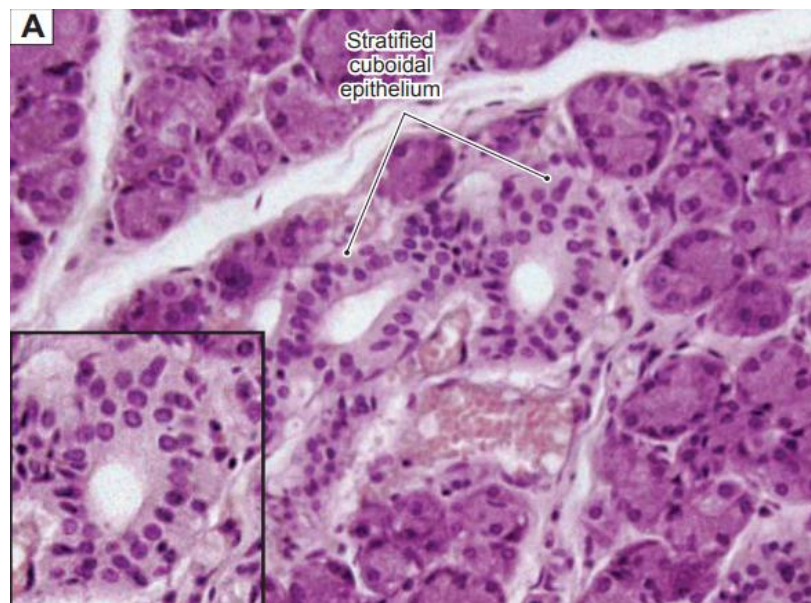


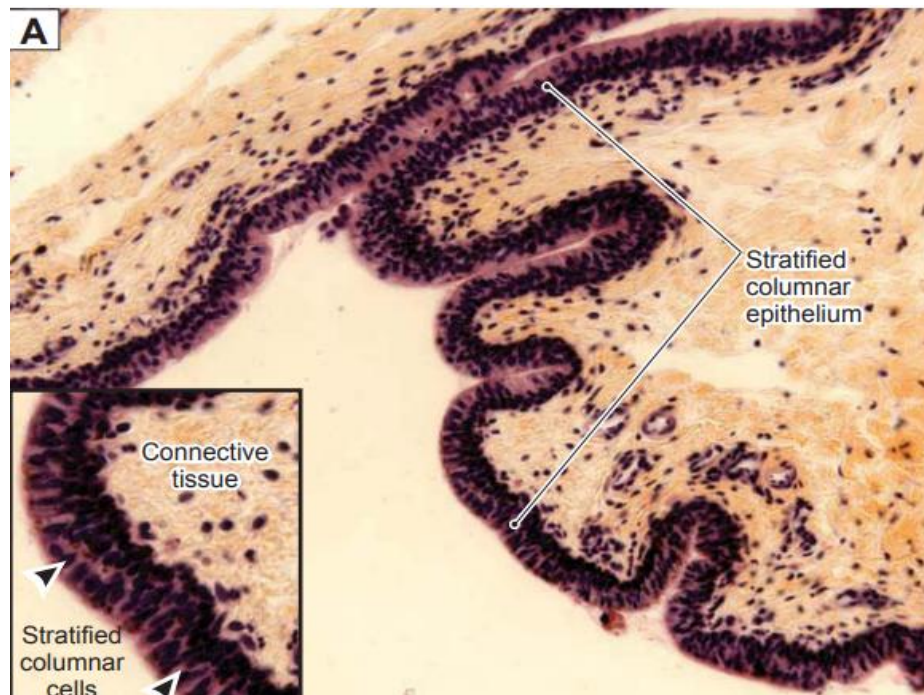
Fig.4.*Stratified squamous epithelia*

2- Stratified cuboidal epithelium : Stratified cuboidal epithelium lines the ducts of the salivary glands. This uncommon type of epithelium has a very limited distribution. It may be found forming the ducts of some large exocrine glands and sweat glands. It functions to form a conduit for the secretory products of the gland. This type of epithelium is composed usually of only two occasionally three, layers of cuboidal cells. The top layer is composed of uniform cuboidal cells, whereas the basal cells sometimes appear to form an incomplete layer. Cells in stratified cuboidal epithelium often have smooth apical surfaces, and nuclei are centrally located layers of cuboidal cells, with the basal layer of cells often appearing incomplete.



3-Stratified columnar epithelia; is a rare type of epithelial tissue composed of column shaped cells arranged in multiple layers. It has two or three layers; the top layer is made up of columnar cells, and the basal layer normally consists of cuboidal cells. Stratified columnar epithelium is not a common type of epithelium and is found in only a few

places in the body, for example, the larger ducts of some exocrine glands and in the ocular conjunctiva of the eye, in parts of the pharynx and anus, the female's uterus, the male urethra and vas deferens. Also found in intralobular ducts in salivary glands. The cells function is secretion and protection.



4- Transitional epithelium:

The transitional epithelium lining the urinary tract including the bladder, ureter, and major calyces of the kidney. These cells change shape according to the degree of distention of the bladder. In the relaxed state, transitional epithelium contains four to six cell layers, and each surface cell appears dome shaped, often containing two nuclei (these cells are “binucleate”). These cells, sometimes called umbrella cells.. When the transitional epithelium is stretched, the top dome-shaped cells become flattened squamous cells and the epithelium becomes thinner are essentially protective against the hypertonic and potentially cytotoxic

effects of urine. Importantly, the form of the surface cells changes according to the degree of distention of the bladder wall (Fig.5)

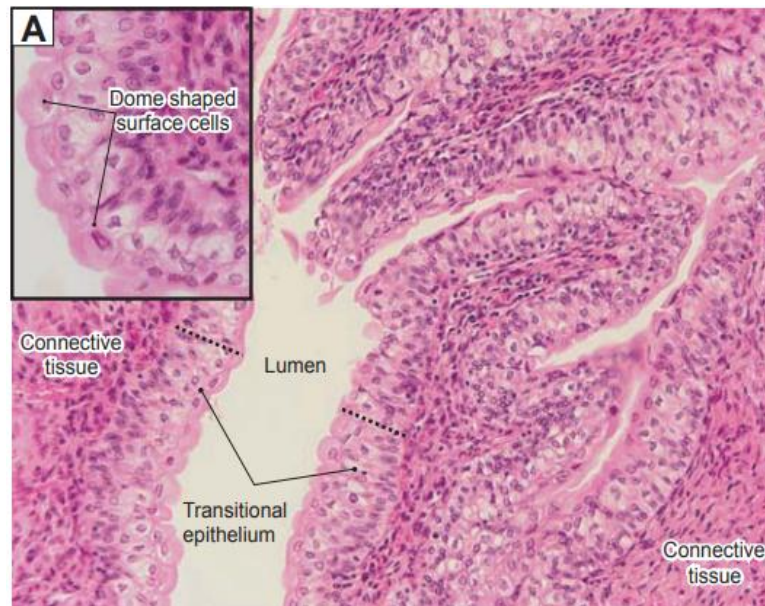


Fig.5. *Transitional Epithelium*

SUMMARIZED OF EPITHELIAL TISSUE

Types of Epithelia	Number of Layers	Type of Cells in the Epithelium	Apical Surface	Main Locations (Lining)	Main Functions
Simple squamous epithelium	One	Flattened, squamous epithelial cells	Smooth	Cornea, blood, and lymphatic vessels—endothelium; surface of body cavities—mesothelium (pleural, pericardial, peritoneal); alveoli in the lung	Fluid transport, lubrication, and exchange
Simple cuboidal epithelium	One	Cuboidal epithelial cells (height equal to width)	Smooth/short microvilli; long microvilli depending on location	Kidney tubules, thyroid follicles; small ducts of exocrine glands and surface of ovary	Absorption, secretion, and transportation
Simple columnar epithelium	One	Absorptive columnar cells and secretory cells, such as goblet cells	Mostly microvilli; cilia in some locations	Most of digestive tract and gallbladder; oviducts and ductuli efferentes	Secretion, absorption, protection, and transportation
Pseudostratified columnar epithelium	One	Ciliated columnar cells, goblet cells, and short basal cells not reaching lumen; all cells rest on the basement membrane	Mostly cilia; stereocilia in some locations	Most of respiratory tract; ductus deferens and epididymis	Secretion, transportation, and absorption
Stratified squamous epithelium	Several	Flattened surface cells, polygonal cells in the middle layers, and cuboidal cells in basal layer	Keratinized or nonkeratinized surface layer	Epidermis of the skin; oral cavity, epiglottis, and esophagus; vagina	Protection (barrier)
Stratified cuboidal epithelium	Two to three	Cuboidal cells	Mostly smooth	Large ducts of exocrine glands and ducts of sweat gland (not common type)	Transportation
Stratified columnar epithelium	Two to three	Low columnar surface cells and cuboidal basal cells	Smooth	Large ducts of exocrine glands; conjunctiva of the eye (not common type)	Transportation and protection
Transitional epithelium	Four to six layers (relaxed); two to three layers (distended)	Dome-shaped surface cells (relaxed), polygonal in the middle layer, cuboidal cells in the basal layer	Smooth	Urinary tract	Transportation and protection (distensible property)

Epithelia: Some Clinical Considerations

Regeneration: epithelial cells have a capacity for regeneration (e.g. in skin wound healing, in the replacement of surface cells of the skin and cells lining the gastro-intestinal tract and the renewal of uterine lining cells following menstruation).

Metaplasia: some epithelia have the capacity to change from one type to another (e.g. in heavy smoker ,the pseudostratified columnar epithelium of the respiratory tract may become stratified squamous in type)

Neoplasia: in disease (e.g. in cancer) changes may occur in epithelia giving rise to a tumor (neoplasm)which is termed a carcinoma . The cells

in benign tumors resemble those of their tissue of origin but those in malignant tumors have altered or abnormal cell structure and also invade adjacent tissues.