Epithelial lining of gastrointestinal tract

By

Mohamed Salem Ali Salem

Doi: 10.21608/ajsr.2022.236288

Salem , Mohamed Salem Ali (2022). Epithelial lining of gastrointestinal tract. ***The Arab Journal of Scientific Research***, AIESA, Vol. 6 Issue 6.pp 13-26.

https://ajsr.journals.ekb.eg

Epithelial lining of gastrointestinal tract

Preamble:

The food you eat takes an incredible journey through your body, from top (your mouth) to bottom (your anus). Along the way the beneficial parts of your food are absorbed, giving you energy and nutrients. Here's a step-by-step account of the digestive system's workings. In general, epithelial tissues are classified by the number of their layers and by the shape and function of the cells. The three principal shapes associated with epithelial cells are squamous, cuboidal, and columnar.

- **Squamous epithelium** has cells that are wider than their height (flat and scale-like). This is found as the lining of the mouth, oesophagus, and including blood vessels and in the alveoli of the lungs.
- **Cuboidal epithelium** has cells whose height and width are approximately the same (cube shaped).
- **Columnar epithelium** has cells taller than they are wide (column-shaped). Columnar epithelium can be further classified into ciliated columnar epithelium and glandular columnar epithelium.

By layer, epithelium is classed as either simple epithelium, only one cell thick (unilayered), or stratified epithelium having two or more cells in thickness, or multi-layered – as stratified squamous epithelium, stratified cuboidal epithelium, and stratified columnar epithelium,[6][7] and both types of layering can be made up of any of the cell shapes. However, when taller simple columnar epithelial cells are viewed in cross section showing several nuclei appearing at different heights, they can be confused with stratified epithelia. This kind of epithelium is therefore described as pseudostratified columnar epithelium.

Transitional epithelium has cells that can change from squamous to cuboidal, depending on the amount of tension on the epithelium.[9]

Simple epithelium[edit]

Simple epithelium is a single layer of cells with every cell in direct contact with the basement membrane that separates it from the underlying connective tissue. In general, it is found where absorption and filtration occur. The thinness of the epithelial barrier facilitates these processes.

In general, simple epithelial tissues are classified by the shape of their cells. The four major classes of simple epithelium are (1) simple squamous, (2) simple cuboidal, (3) simple columnar, and (4) pseudostratified.

(1) Simple squamous: Squamous epithelial cells appear scale-like, flattened, or rounded (e.g., walls of capillaries, linings of the pericardial, pleural, and peritoneal cavities, linings of the alveoli of the lungs).

(2) Simple cuboidal: These cells may have secretory, absorptive, or excretory functions. Examples include small collecting ducts of the kidney, pancreas, and salivary gland.

(3) Simple columnar: Cells can be secretory, absorptive, or excretory. Simple columnar epithelium can be ciliated or non-ciliated; ciliated columnar is found in the female reproductive tract and uterus. Non-ciliated epithelium can also possess microvilli. Some tissues contain goblet cells and are referred to as simple glandular columnar epithelium. These secrete mucus and are found in the stomach, colon, and rectum.

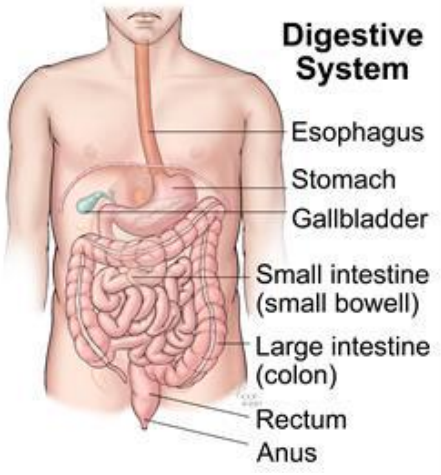
(4) Pseudostratified columnar epithelium: These can be ciliated or non-ciliated. The ciliated type is also called respiratory epithelium since it is almost exclusively confined to the larger respiratory airways of the nasal cavity, trachea, and bronchi.

Stratified epithelium

Stratified or compound epithelium differs from simple epithelium in that it is multilayered. It is therefore found where body linings have to withstand mechanical or chemical insult such that layers can be abraded and lost without exposing subepithelial layers. Cells flatten as the layers become more apical, though in their most basal layers, the cells can be squamous, cuboidal, or columnar.

Stratified epithelia (of columnar, cuboidal, or squamous type) can have the following specializations

Mouth



The mouth is the beginning of the digestive tract. In fact, digestion starts before you even take a bite. Your salivary glands get active as you see and smell that pasta dish or warm bread. After you start eating, you chew your food into pieces that are more easily digested. Your saliva mixes with the food to begin to break it down into a form your body can absorb and use. When you swallow, your tongue passes the food into your throat and into your esophagus.

Esophagus

Located in your throat near your trachea (windpipe), the esophagus receives food from your mouth when you swallow. The epiglottis is a small flap that folds over your windpipe as you swallow to prevent you from choking (when food goes into

your windpipe). A series of muscular contractions within the esophagus called peristalsis delivers food to your stomach.
But first a ring-like muscle at the bottom of your esophagus called the lower esophageal sphincter has to relax to let the food in. The sphincter then contracts and prevents the contents of the stomach from flowing back into the esophagus. (When it doesn't and these contents flow back into the esophagus, you may experience acid reflux or heartburn.)

Stomach

The stomach is a hollow organ, or "container," that holds food while it is being mixed with stomach enzymes. These enzymes continue the process of breaking down food into a usable form. Cells in the lining of your stomach secrete a strong acid and powerful enzymes that are responsible for the breakdown process. When the contents of the stomach are processed enough, they're released into the small intestine.

Small intestine

Made up of three segments — the duodenum, jejunum, and ileum — the small intestine is a 22-foot long muscular tube that breaks down food using enzymes released by the pancreas and bile from the liver. Peristalsis also works in this organ, moving food through and mixing it with digestive juices from the pancreas and liver.
The duodenum is the first segment of the small intestine. It's largely responsible for the continuous breaking-down process. The jejunum and ileum lower in the intestine are mainly responsible for the absorption of nutrients into the bloodstream.
Contents of the small intestine start out semi-solid and end in a liquid form after passing through the organ. Water, bile, enzymes and mucus contribute to the change in consistency. Once the nutrients have been absorbed and the leftover-food residue liquid has passed through the small intestine, it then moves on to the large intestine, or colon.

Pancreas

The pancreas secretes digestive enzymes into the duodenum that break down protein, fats and carbohydrates. The pancreas also makes insulin, passing it directly into the bloodstream. Insulin is the chief hormone in your body for metabolizing sugar.

Liver

The liver has many functions, but its main job within the digestive system is to process the nutrients absorbed from the small intestine. Bile from the liver secreted into the small intestine also plays an important role in digesting fat and some vitamins.

The liver is your body's chemical "factory." It takes the raw materials absorbed by the intestine and makes all the various chemicals your body needs to function.

The liver also detoxifies potentially harmful chemicals. It breaks down and secretes many drugs that can be toxic to your body.

Gallbladder

The gallbladder stores and concentrates bile from the liver, and then releases it into the duodenum in the small intestine to help absorb and digest fats.

Colon (Large Intestine)

The large intestine, or colon, is responsible for processing waste so that emptying the bowels is easy and convenient. It’s a 6-foot long muscular tube that connects the small intestine to the rectum.

The large intestine is made up of the cecum, the ascending (right) colon, the transverse (across) colon, the descending (left) colon, and the sigmoid colon, which connects to the rectum.

Stool, or waste left over from the digestive process, is passed through the colon by means of peristalsis, first in a liquid state and ultimately in a solid form. As stool passes through the

colon, water is removed. Stool is stored in the sigmoid (S-shaped) colon until a "mass movement" empties it into the rectum once or twice a day.

It normally takes about 36 hours for stool to get through the colon. The stool itself is mostly food debris and bacteria. These "good" bacteria perform several useful functions, such as synthesizing various vitamins, processing waste products and food particles and protecting against harmful bacteria. When the descending colon becomes full of stool, or feces, it empties its contents into the rectum to begin the process of elimination (a bowel movement).

Rectum

The rectum is a straight, 8-inch chamber that connects the colon to the anus. The rectum's job is to receive stool from the colon, let you know that there is stool to be evacuated (pooped out) and to hold the stool until evacuation happens. When anything (gas or stool) comes into the rectum, sensors send a message to the brain. The brain then decides if the rectal contents can be released or not.

If they can, the sphincters relax and the rectum contracts, disposing its contents. If the contents cannot be disposed, the sphincter contracts and the rectum accommodates so that the sensation temporarily goes away.

Anus

The anus is the last part of the digestive tract. It is a 2-inch long canal consisting of the pelvic floor muscles and the two anal sphincters (internal and external). The lining of the upper anus is able to detect rectal contents. It lets you know whether the contents are liquid, gas or solid.

The anus is surrounded by sphincter muscles that are important in allowing control of stool. The pelvic floor muscle creates an angle between the rectum and the anus that stops stool from coming out when it's not supposed to. The internal

sphincter is always tight, except when stool enters the rectum. This keeps us continent (prevents us from pooping involuntarily) when we are asleep or otherwise unaware of the presence of stool.

When we get an urge to go to the bathroom, we rely on our external sphincter to hold the stool until reaching a toilet, where it then relaxes to release the contents.

Specialization	Description
Keratinized	In this particular case, the most apical layers (exterior) of cells are dead and lose their nucleus and cytoplasm, instead contain a tough, resistant protein called keratin. This specialization makes the epithelium somewhat water-resistant, so is found in the mammalian skin. The lining of the esophagus is an example of a non-keratinized or "moist" stratified epithelium.
Parakeratinized	In this case, the most apical layers of cells are filled with keratin, but they still retain their nuclei. These nuclei are pyknotic, meaning that they are highly condensed. Parakeratinized epithelium is sometimes found in the oral mucosa and in the upper regions of the esophagus.
Transitional	Transitional epithelia are found in tissues that stretch, and it can appear to be stratified cuboidal when the tissue is relaxed, or stratified squamous when the organ is distended and the tissue stretches. It is sometimes called urothelium since it is almost exclusively found in

	the bladder, ureters and urethra.

The basic cell types are squamous, cuboidal, and columnar, classed by their shape.

Type	Description
Squamous	Squamous cells have the appearance of thin, flat plates that can look polygonal when viewed from above.[12] Their name comes from *squāma*, Latin for "scale" – as on fish or snake skin. The cells fit closely together in tissues, providing a smooth, low-friction surface over which fluids can move easily. The shape of the nucleus usually corresponds to the cell form and helps to identify the type of epithelium. Squamous cells tend to have horizontally flattened, nearly oval-shaped nuclei because of the thin, flattened form of the cell. Squamous epithelium is found lining surfaces such as skin or alveoli in the lung, enabling simple passive diffusion as also found in the alveolar epithelium in the lungs. Specialized squamous epithelium also forms the lining of cavities such as in blood vessels (as endothelium), in the pericardium (as mesothelium), and in other body cavities.
Cuboidal	Cuboidal epithelial cells have a cube-like shape and appear square in cross-section. The cell nucleus is large, spherical and is in the center of the cell. Cuboidal epithelium is commonly found in secretive tissue such as the exocrine glands, or in absorptive tissue

	such as the pancreas, the lining of the kidney tubules as well as in the ducts of the glands. The germinal epithelium that covers the female ovary, and the germinal epithelium that lines the walls of the seminferous tubules in the testes are also of the cuboidal type. Cuboidal cells provide protection and may be active in pumping material in or out of the lumen, or passive depending on their location and specialisation. Simple cuboidal epithelium commonly differentiates to form the secretory and duct portions of glands. Stratified cuboidal epithelium protects areas such as the ducts of sweat glands, mammary glands, and salivary glands.
Columnar	Columnar epithelial cells are elongated and column-shaped and have a height of at least four times their width. Their nuclei are elongated and are usually located near the base of the cells. Columnar epithelium forms the lining of the stomach and intestines. The cells here may possess microvilli for maximizing the surface area for absorption, and these microvilli may form a brush border. Other cells may be ciliated to move mucus in the function of mucociliary clearance. Other ciliated cells are found in the fallopian tubes, the uterus and central canal of the spinal cord. Some columnar cells are specialized for sensory reception such as in the nose, ears and the taste buds. Hair cells in the inner

	ears have stereocilia which are similar to microvilli. Goblet cells are modified columnar cells and are found between the columnar epithelial cells of the duodenum. They secrete mucus, which acts as a lubricant. Single-layered non-ciliated columnar epithelium tends to indicate an absorptive function. Stratified columnar epithelium is rare but is found in lobar ducts in the salivary glands, the eye, the pharynx, and sex organs. This consists of a layer of cells resting on at least one other layer of epithelial cells, which can be squamous, cuboidal, or columnar.
Pseudostratified	These are simple columnar epithelial cells whose nuclei appear at different heights, giving the misleading (hence "pseudo") impression that the epithelium is stratified when the cells are viewed in cross section. Ciliated pseudostratified epithelial cells have cilia. Cilia are capable of energy-dependent pulsatile beating in a certain direction through interaction of cytoskeletal microtubules and connecting structural proteins and enzymes. In the respiratory tract, the wafting effect produced causes mucus secreted locally by the goblet cells (to lubricate and to trap pathogens and particles) to flow in that direction (typically out of the body). Ciliated epithelium is found in the

	airways (nose, bronchi), but is also found in the uterus and Fallopian tubes, where the cilia propel the ovum to the uterus.

References

Deakin, Barbara Young; et al. (2006). Wheater's functional histology : a text and colour atlas (5th ed.). Churchill Livingstone/Elsevier. pp. 263–265. ISBN 978-0-4430-6-8508.

"Oral: Four layers of the G.I. tract". The Histology Guide. University of Leeds. Retrieved 4 January 2014.

Gartner and Hiatt (2014). Color Atlas and Text of Histology (6th ed.). Baltimore: Lippincott Williams & Wilkins. ISBN 978-1-4511-1343-3.

Ali Nawaz Khan. "Small-Bowel Obstruction Imaging". Medscape. Retrieved 2017-03-07. Updated: Sep 22, 2016

Jump up to:a b c Fernandes, Teresa; Oliveira, Maria I.; Castro, Ricardo; Araújo, Bruno; Viamonte, Bárbara; Cunha, Rui (2014). "Bowel wall thickening at CT: simplifying the diagnosis". Insights into I