SecretoryEpithelia & Glands

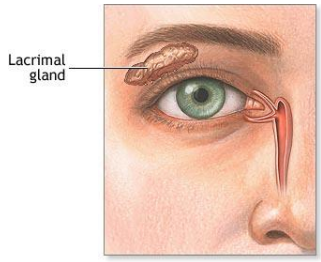
In many structures, an example is in the stomach

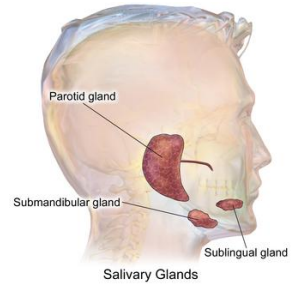
Epithelial cells that function mainly to produce and secrete various macromolecules may occur in epithelia with other major functions or comprise specialized organs called glands.

By Abdallah Al-Saraireh

Secretory Epithelia & Glands

- Synthesize and release of substances: **lipids**, **carbs**, and **proteins**.





Salivary Glands

- Types based **on the presence of duct system**:

A. Exocrine glands (duct) → They have a designated duct system that carry their secretion toward the location that they need to be taken to such as the salivary glands which make the saliva and through the duct system they deliver to the oral cavity , lacrimal gland that's the one that synthesize and secretes an important part of the tears and then it delivers it to the eye

B. Endocrine glands (no duct) → They rely on the bloodstream and the blood vessels that reach them to pick up the hormones, and they are produced to be distributed to the target tissues

Types based **on number of cells**:

A. Unicellular (Goblet cells-**mucous**-secreting cells) — **One cell only**

B. Multicellular

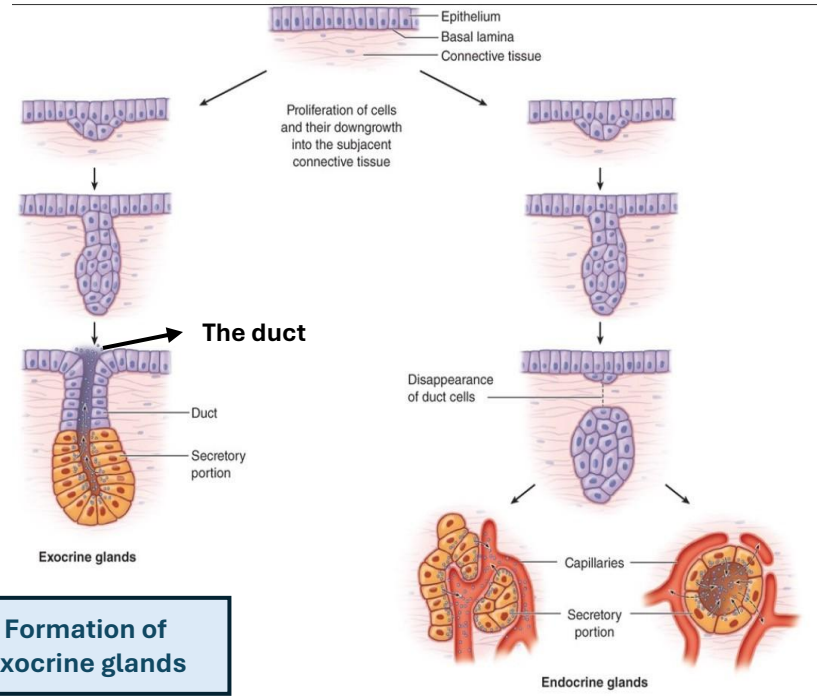
Gland's Formation

- **Develop from covering epithelia in the fetus by cell proliferation and growth into the underlying connective tissue, followed by further differentiation.**

Means multiplying

Which means they are becoming something new, different from their parents

During embryogenesis (embryo life)



Formation of exocrine glands

Formation of endocrine glands

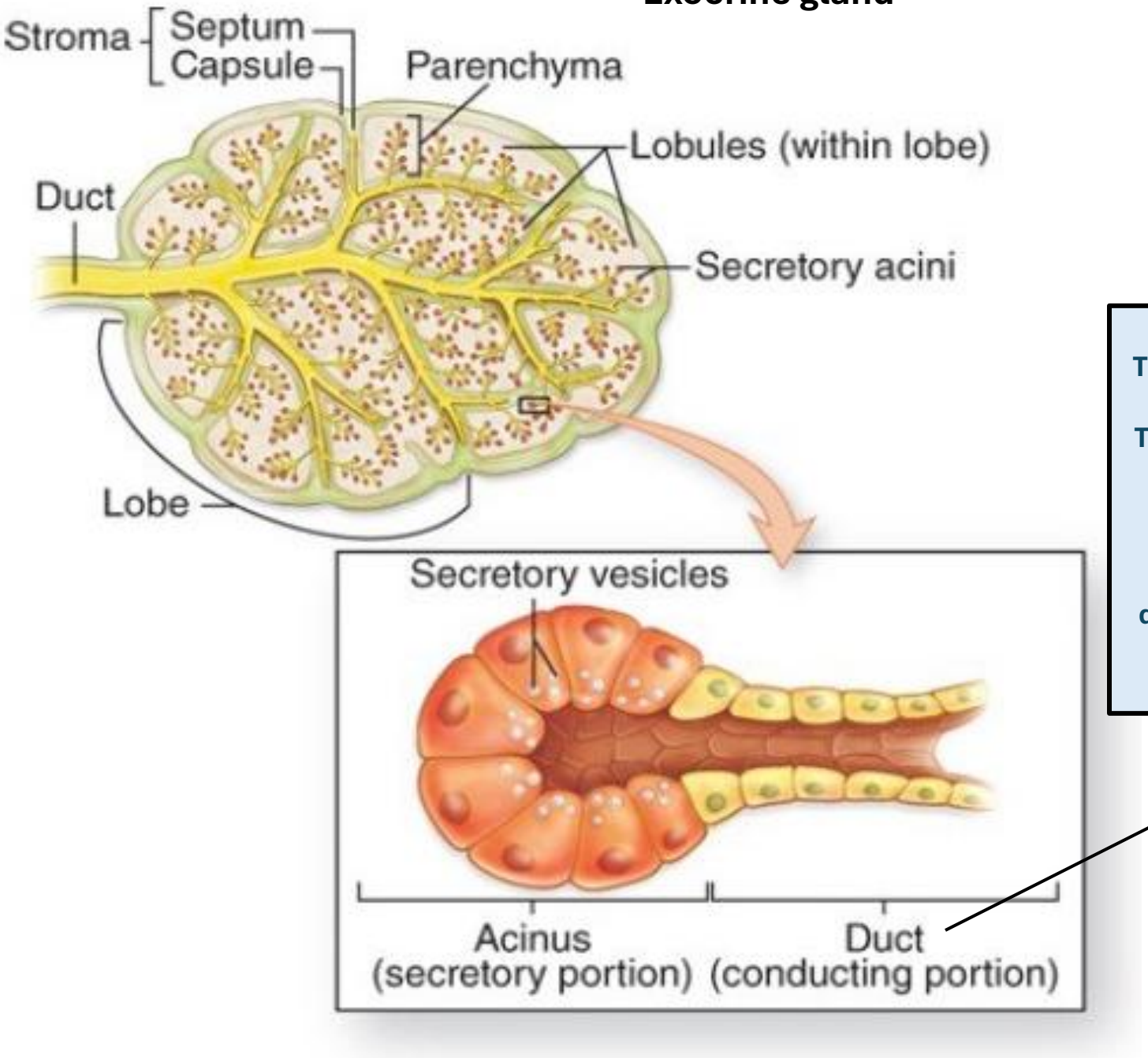
1. If cells retains their connection with the surface=exocrine glands.

2. Lose their connection with the surface=endocrine glands; capillaries surround them to deliver their products (hormones).

Lose the connection to the surface and will no longer have ducts and they will rely on the surrounding blood vessels to uptake the hormones that they have synthesized

Gland Structure

Exocrine gland



Duct system:
The secretory cells are connected to a duct system .
The duct system starts with small ducts, these ducts gradually becomes larger, eventually they form the main excretory duct which opens into the final destination of the secretion, e.g., in the salivary glands, the duct opens into the oral cavity .

Glands are organized into secretory and ducts parts

Parenchyma: represents the functional cells of the gland and it includes:

1- secretory cells: that produce the gland product, form the secretory portion of the gland.

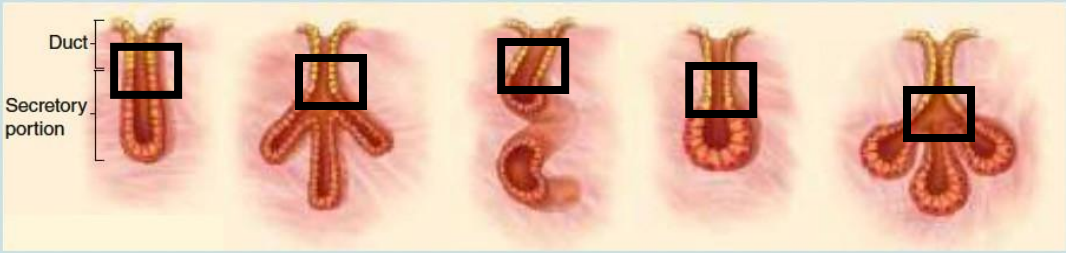
Example: in salivary glands, the secretory cells are acinar cells that produce saliva.

2- duct cells: transport the secreted product

- **Stroma (supporting part): is the connective tissue component of the gland which surrounds the parenchyma, supports and protects it and guides the organization of glandular structures.**
- Glands are usually surrounded by connective tissue capsules.
- Capsules sends septa to divided the gland into smaller compartments; lobes and lobules within it.

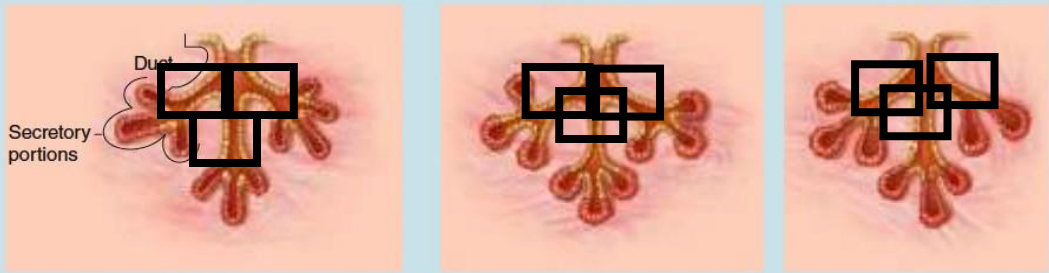
- **The gland is divided into:**
- **Whole gland : Divided into lobes**
- **Each lobe is divided into lobules**
- **Inside the lobules, we fined:**
- **Secretory cells & Duct cells**

SIMPLE Glands (Ducts Do Not Branch)

Class	Simple Tubular	Branched Tubular	Coiled Tubular	Acinar (or Alveolar)	Branched Acinar
					
Features	Elongated secretory portion; duct usually short or absent	Several long secretory parts joining to drain into 1 duct	Secretory portion is very long and coiled	Rounded, saclike secretory portion	Multiple saclike secretory parts entering the same duct
Examples	Mucous glands of colon; intestinal glands or crypts (of Lieberkühn)	Glands in the uterus and stomach	Sweat glands	Small mucous glands along the urethra	Sebaceous glands of the skin

Another name

COMPOUND Glands (Ducts from Several Secretory Units Converge into Larger Ducts)

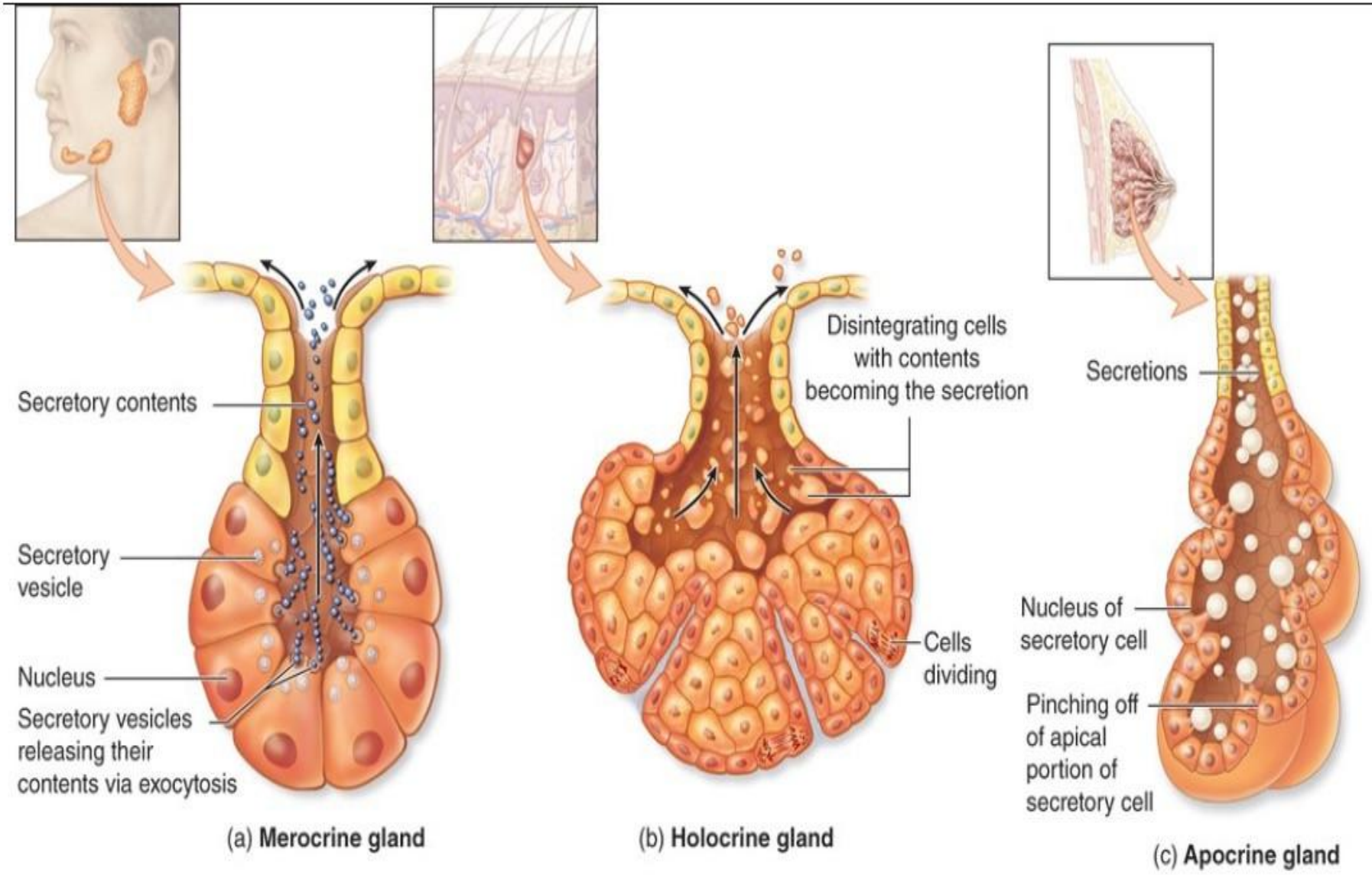
Class	Tubular	Acinar (Alveolar)	Tubuloacinar
			
Features	Several *elongated* coiled secretory units and their ducts converge to form larger ducts	Several *saclike* secretory units with small ducts converge at a larger duct	Ducts of both tubular and acinar secretory units converge at larger ducts
Examples	Submucosal mucous glands (of Brunner) in the duodenum	Exocrine pancreas	Salivary glands

Classification Of Exocrine Glands (based on the complexity of the ducts)

- **Simple glands**: glands with unbranched duct. (one duct)
- **Compound glands**: the ducts have two or more branches.
- The secretory portions can be **tubular** or **acinar** (different in the **nature of the secretory material**).

Types Of Secretion

(how does it release its secretory molecules)



Ms

Merocrine (salivary)

most common method of protein or glycoprotein secretion---exocytosis from membrane-bound vesicles or secretory granules.

1. **Synthesis of saliva components inside secretory cells.**
2. **Packaging into secretory granules.**
3. **Movement of granules to the apical surface.**
4. **Release by exocytosis.**
5. **Formation of primary (crude) saliva.**
6. **Modification in the duct system before reaching the oral cavity.**

Mamma and Apo

Apocrine (mammary)

product accumulates at the cells' apical ends, portions of which are then extruded to release the product together with small amounts of cytoplasm and cell membrane

Apocrine secretion is a mode of secretion seen in mammary glands of females.

- **It is especially active during pregnancy and after childbirth.**
- **During pregnancy, the mammary glands undergo proliferation and develop a stronger secretory function.**

- **Mammary gland cells synthesize the required nutrients and molecules needed for milk.**
- **These substances accumulate at the apical part of the cell.**
- **The apical portion of the cell bulges outward.**
- **A portion of the apical cytoplasm is pinched off and released.**

- **In apocrine secretion, part of the cell membrane and cytoplasm is lost with the secretion.**

Result:

- **The released material contains nutrients necessary for the baby.**
- **This secretion forms breast milk.**

Holo = whole then
se = self

Holocrine (sebaceous)

Whole **SELF**

cells accumulate product continuously as they enlarge and undergo terminal differentiation, culminating in complete cell disruption which releases the product and cell debris into the gland's lumen.

Holocrine secretion is a mode of secretion in which the entire cell becomes part of the secretion.

- **A common example is the sebaceous glands.**
- **Sebaceous glands are associated with hair follicles at their base in the skin.**

- **The glandular cells synthesize sebum (an oily secretion).**
- **As the cells produce sebum, they increase in size.**
- **The cells continue to enlarge until they reach final maturation.**
- **At this stage, they undergo terminal differentiation.**

- **The entire cell breaks down and is released into the lumen of the gland.**
- **The cell contents become part of the secretion itself.**

- **The secretion moves:**
- **through the duct system**
- **then exits through an opening on the skin surface.**

Nature Of Secretory Products

- Exocrine glands secretion is categorized based on **the nature of their secretory products** into serous or mucous.

- **Serous cells synthesize proteins (mostly not glycosylated; digestive enzymes)--- well-developed RER and Golgi complexes and are filled apically with secretory granules in different stages of maturation---stain intensely with basophilic or acidophilic stains.**

- **Mucous cells filled apically with secretory granules contain heavily glycosylated proteins called mucins (when released from the cell---become hydrated and form a layer of mucus)---hydrophilic mucins are usually washed from cells during routine histological preparations, causing the secretory granules to stain poorly.**

Types of Exocrine Glands (Based on Nature of Secretion)

1. Serous Glands
- Produce watery secretion.
- Secretion is thin and fluid.
- Cells are called serous cells.

2. Mucous Glands
- Produce mucus-rich secretion.
- Secretion is thick and viscous.
- Cells are called mucous cells.

3. Mixed Glands
- Contain both serous and mucous cells.
- Produce both watery and thick secretions.

Nature Of Secretory Products

- **Some salivary glands are mixed seromucous glands, having both serous acini and mucous tubules**
- **Myoepithelial cells: contractile at the basal ends of the secretory cells. Long processes of these cells embrace an acinus. Are rich in actin and myosin filament--- strong contractions serve to propel secretory products from acini into the duct system.**

Myoepithelial Cells

- **Special cells present in exocrine glands.**
- **Myo → muscle**
- **Epithelial → epithelial origin.**
- **They contain actin and myosin filaments. Therefore, they can contract.**

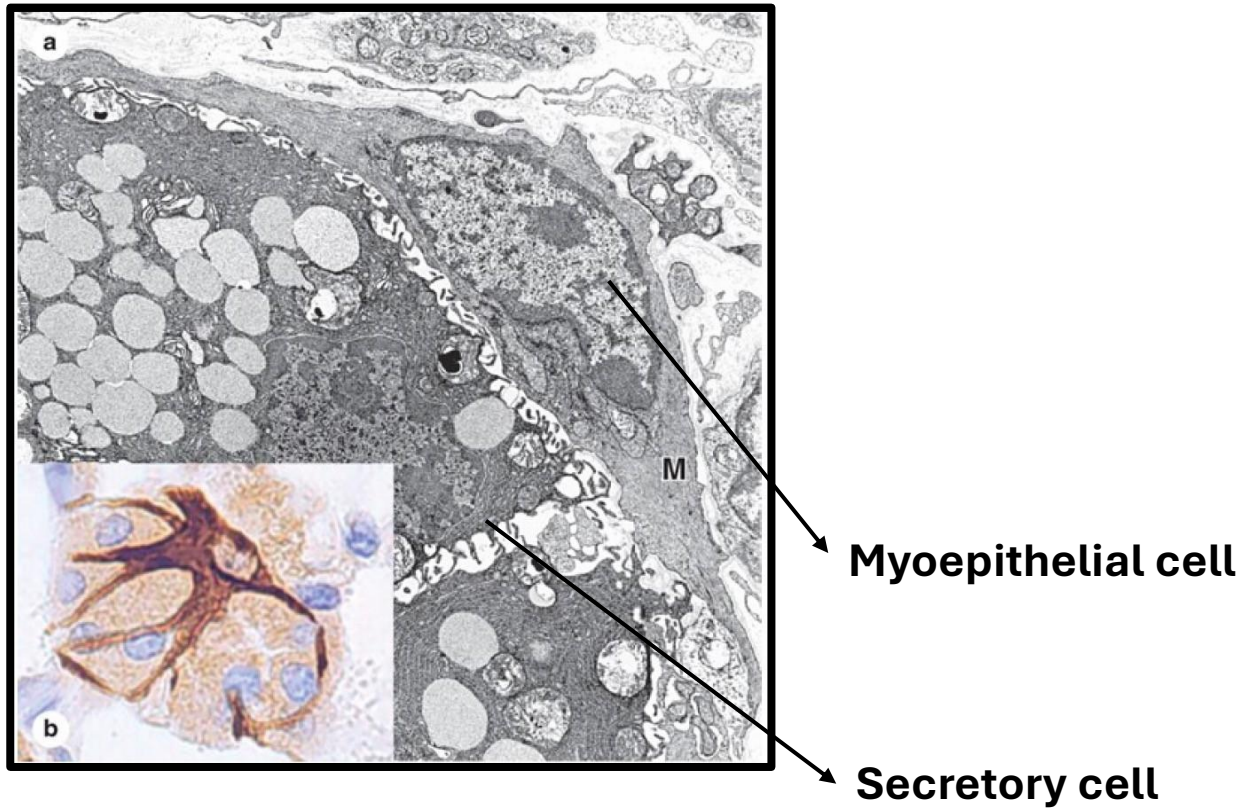
- **Their contraction helps push the secretory product from the acini (secretory units) into the duct system.**

- **They lie around the secretory cells.**
- **Have finger-like cytoplasmic processes that surround the secretory units.**
- **When they contract, they squeeze the acini, helping secretion move into the ducts.**

Myoepithelial Cells

- In exocrine glands only

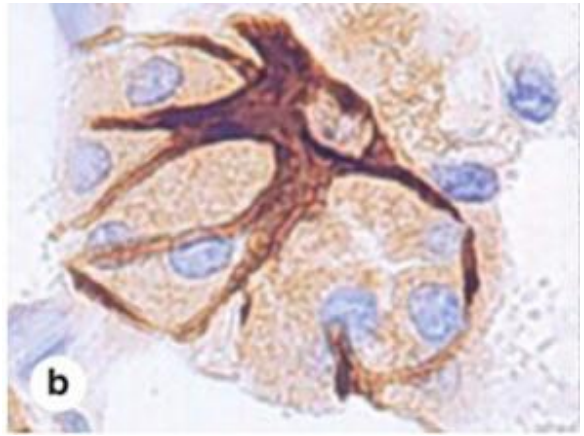
- Contractile cells at the basal ends of the secretory cells---long processes of these cells embrace acini.
- Connected to the other epithelial cells by both gap junctions and desmosomes.



Immunohistochemistry (IHC)

- A staining technique used to detect specific proteins in cells using antigen–antibody reactions.

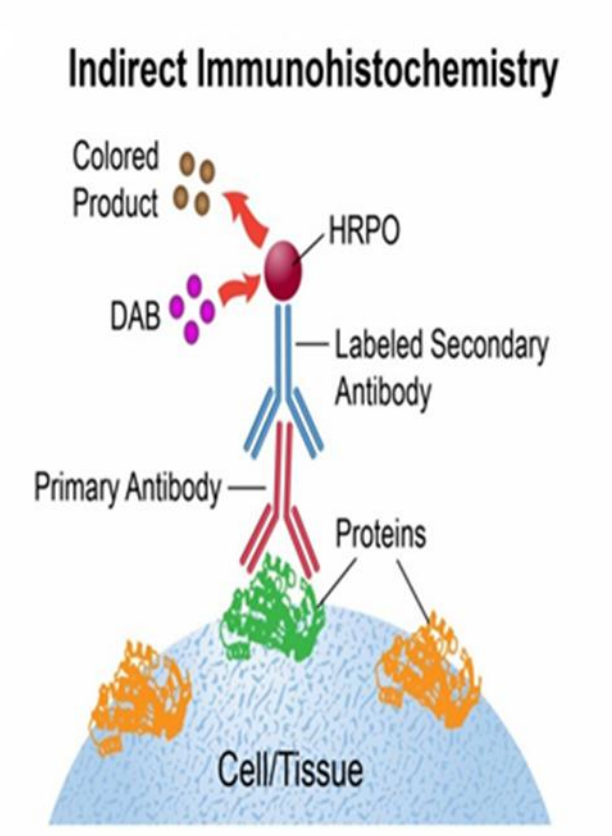
- Observed using a bright-field light microscope.



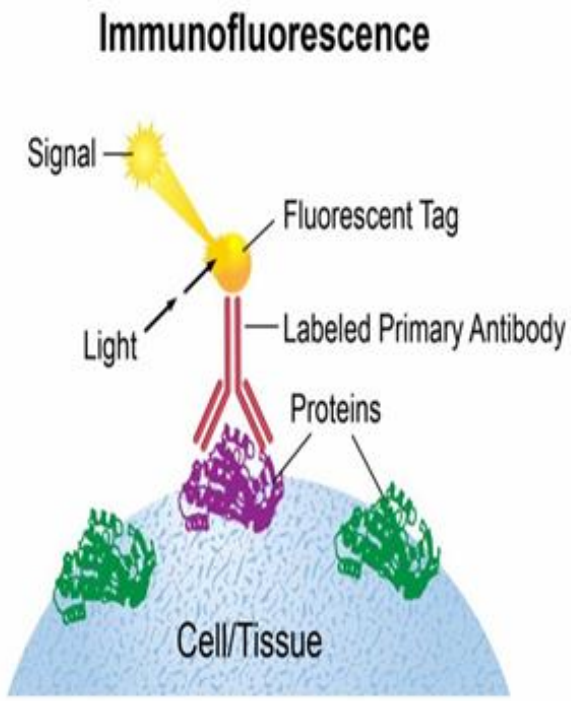
1. Target protein (antigen) is present in the cell.
2. A primary antibody binds to this antigen.
3. A secondary antibody binds to the primary antibody to amplify the signal.

The secondary antibody carries an enzyme.

- When a substrate is added:
- The enzyme reacts with it.
- This produces a brown color that marks the location of the protein.



- **Secondary antibody carries an enzyme**
- **Substrate reaction produces brown staining**
- **Observed using bright-field light microscope**

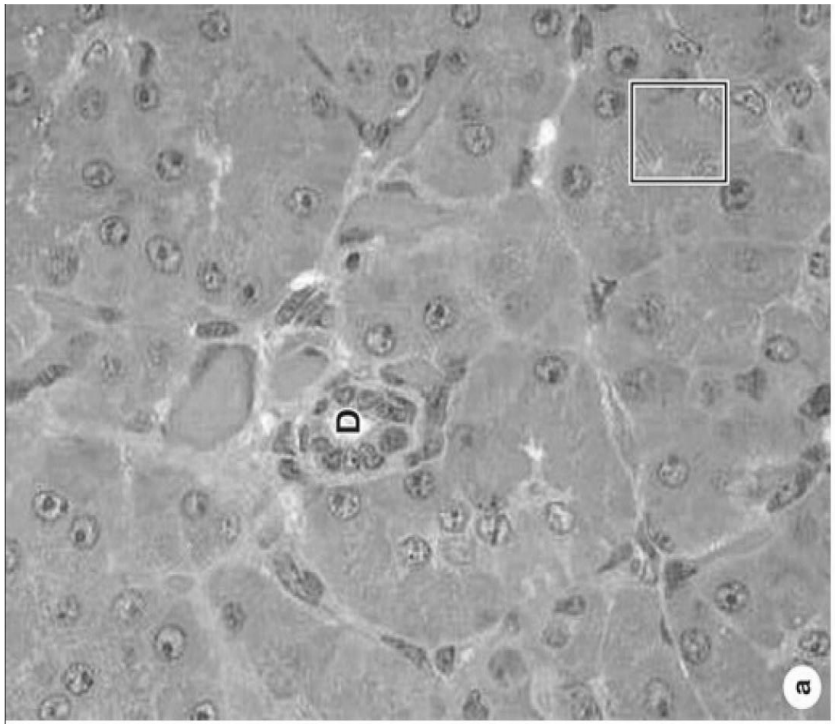


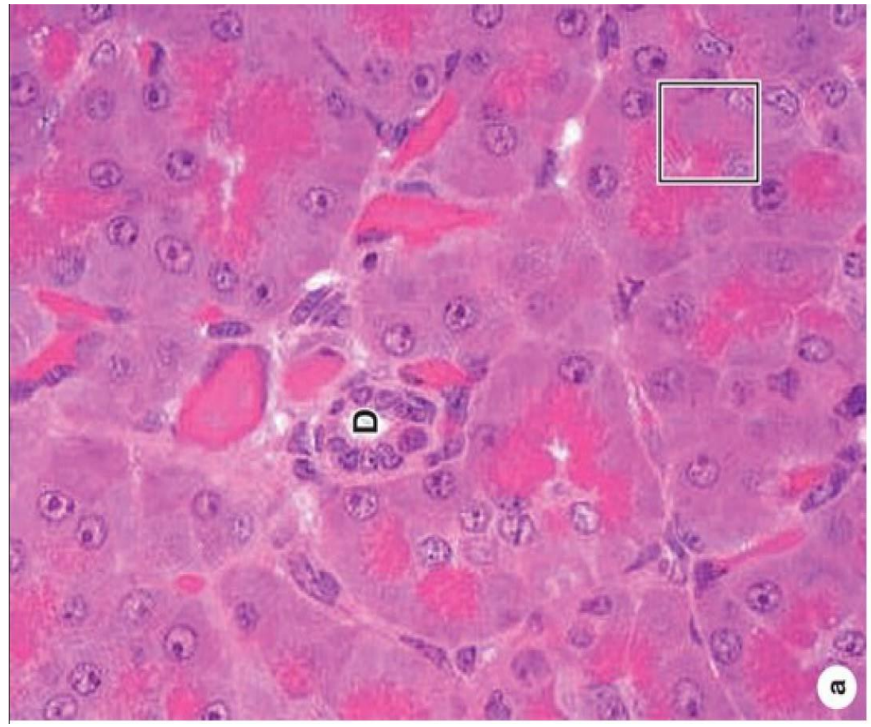
- Secondary antibody carries a fluorophore.

- **Fluorophore:**
- **Excited by a specific wavelength.**
- **Emits a longer wavelength seen as fluorescent color.**

Merocrine

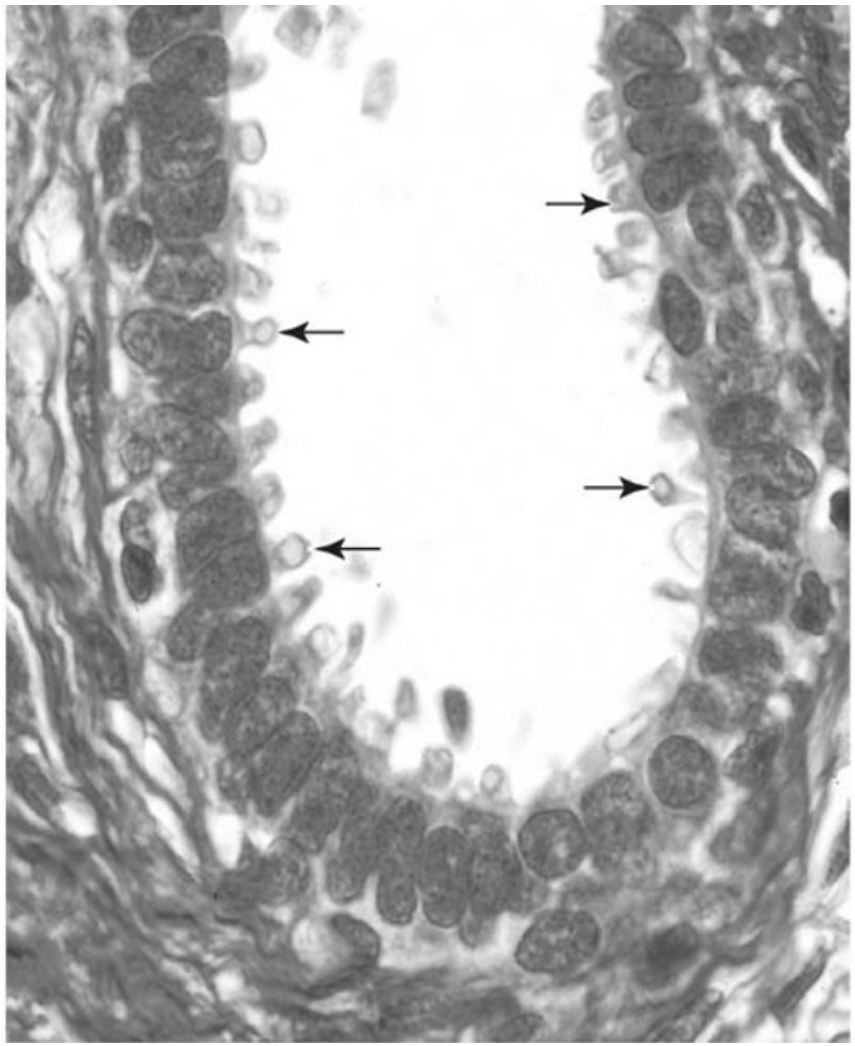
- Secretion stored in secretory granules.
- Granules move to apical surface.
- Released by exocytosis.
- Product enters lumen → ducts → larger ducts.

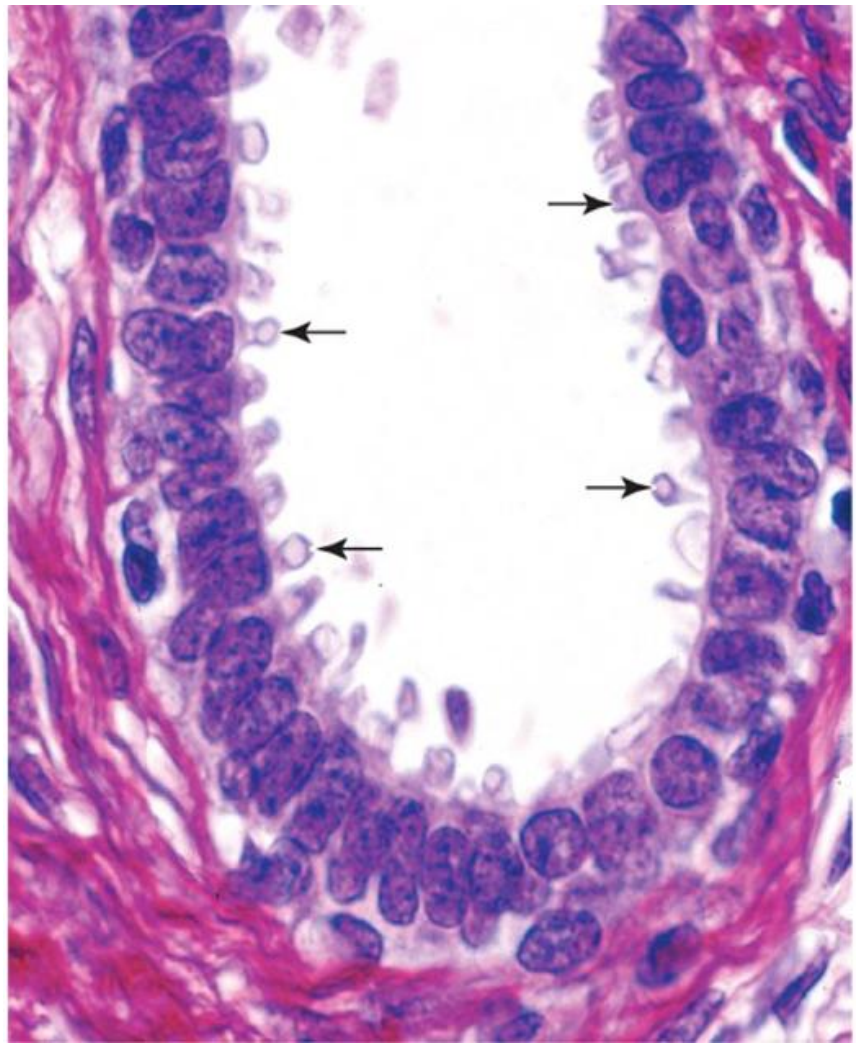




Apocrine

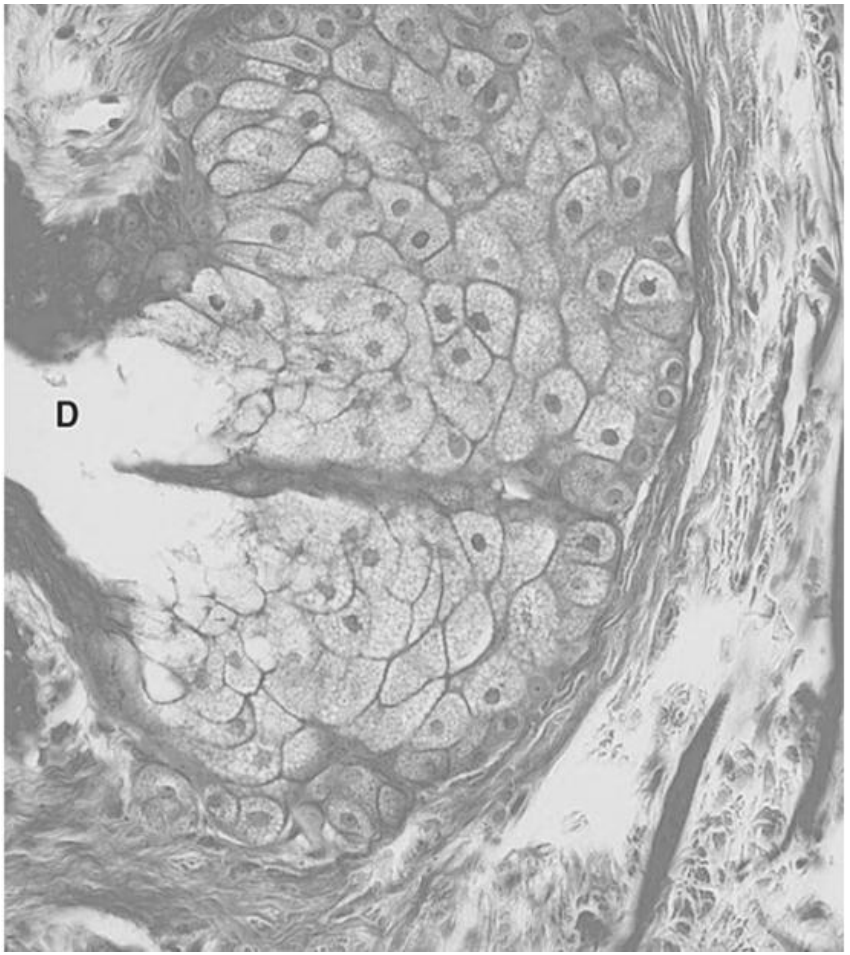
- Secretion accumulates in the apical part of the cell.
- Part of the apical cytoplasm is released with the secretion.
- Example: mammary glands.





Holocrine

- Cells accumulate lipids while differentiating.
- Entire cell degenerates and becomes part of the secretion.
- Product released as whole cell contents.
- Example: sebaceous glands producing sebum.

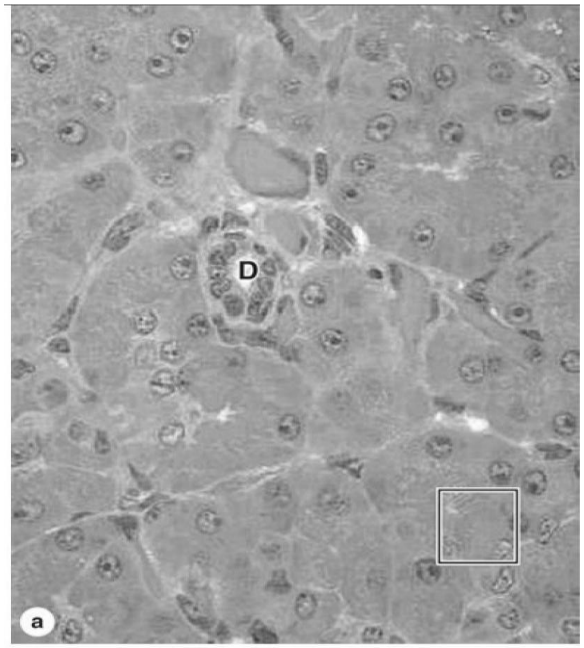


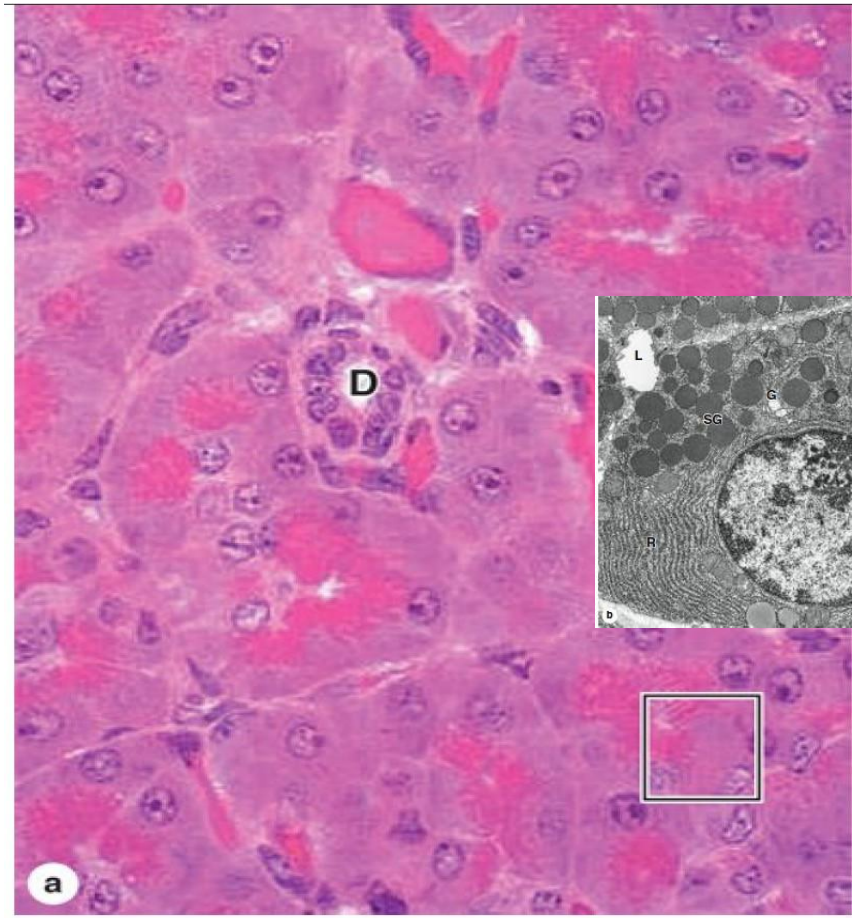
Serous Cells

- Produce watery secretion.

Contain:

- Rough endoplasmic reticulum (RER)
- Secretory granules
- Have round dark nuclei
- Secretion released into the lumen of the secretory unit





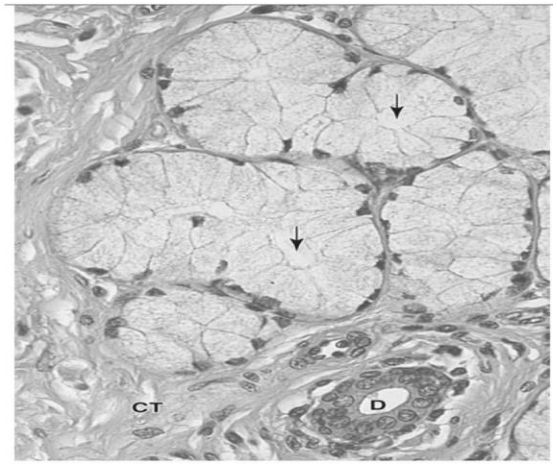
Movement of Secretion

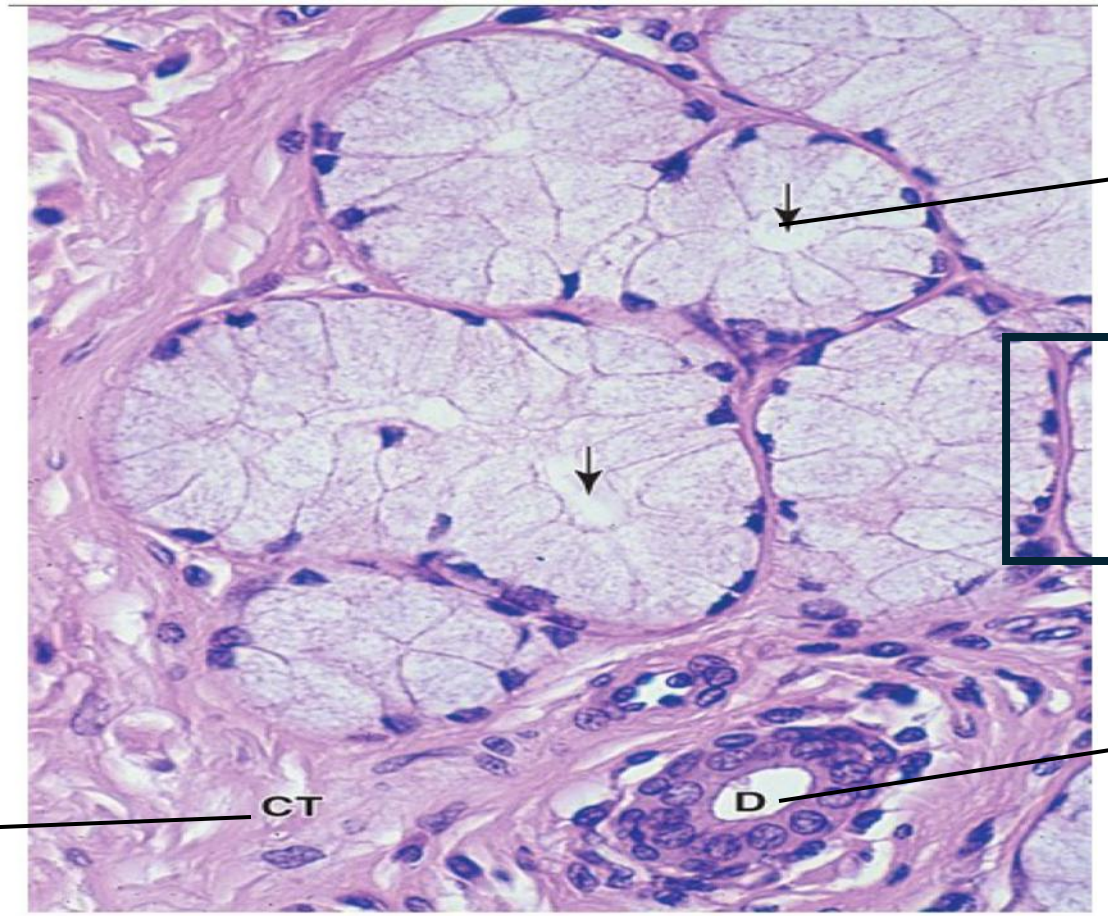
After secretion enters the lumen:

1. **Moves to small ducts**
2. **Then to larger ducts**
3. **Finally, to the largest duct and the final destination**

Mucous Cells

- Produce thick mucous secretion.
- Cytoplasm appears pale or washed out.
- This is due to hydrophilic glycosylated proteins (mucins).
- Nuclei are usually located basally.





lumen

Nuclei are usually located basally

duct

Connective tissue

1- During embryonic development, a specific group of epithelial cells proliferates and invades the underlying connective tissue. If these cells completely disappear their connection with the surface epithelium, which of the following is the most likely fate of the resulting structure?

A) It will transform into myoepithelial cells to support the stroma.

B) It will form a compound tubuloacinar gland like the salivary glands.

C) It will differentiate into a unicellular goblet cell within the surface epithelium.

D) It will become an endocrine gland, secreting hormones directly into surrounding capillaries.

E) It will function as an exocrine gland discharging secretions through a duct system.

(D)

2- A medical student is examining a histological section of the pancreas. She identifies the 'Parenchyma' of the gland. According to the structural organization of glands, which components is she specifically looking at?

A) The extracellular matrix and collagen fibers within the lobules.

B) The blood vessels and nerves supplying the glandular tissue.

C) The secretory units (acini) and the entire duct system.

D) Only the specialized myoepithelial cells surrounding the acini.

E) The capsule and the connective tissue septa dividing the lobes.

(C)

3- A gland is characterized by having several long secretory parts that join together to drain into a single, unbranched duct. How should this gland be classified?

A) Compound tubular gland

B) Coiled tubular gland

C) Simple tubular gland

D) Compound tubuloacinar gland

E) Simple branched tubular gland

(E)

4- Which of the following glands utilizes a mechanism of secretion where the product is released through the complete disruption and death of the secretory cell?

A) Salivary glands

B) Sebaceous glands

C) Sweat glands

D) Mammary glands

E) Exocrine pancreas

(B)

5- In a histological preparation, a certain cell type appears to have poorly stained secretory granules. The professor explains that this is because the glycosylated proteins within were washed away. These cells are most likely:

A) Plasma cells

B) Serous cells

C) Parenchymal duct cells

D) Myoepithelial cells

E) Mucous cells

(E)

6- What is the primary functional role of myoepithelial cells in exocrine glands, and where are they specifically located?

A) Propelling secretory products; located at the basal ends of secretory cells.

B) Secreting mucins; located at the apical ends of cells.

C) Providing structural support; located in the capsule.

D) Synthesizing hormones; located in the stroma.

E) Filtering the blood; located in the capillaries surrounding the acini.

(A)

7-A biopsy of the duodenum reveals glands located in the submucosa (Brunner's glands) that have several elongated coiled secretory units converging into larger ducts. These are classified as:

A) Simple branched acinar

B) Simple coiled tubular

C) Compound tubuloacinar

D) Compound acinar

E) Compound tubular

(E)

8- Serous cells are described as having well-developed RER and Golgi complexes. This ultrastructural feature is most consistent with their function of:

A) Forming a protective barrier against acidic pH.

B) Storing large amounts of lipids and triglycerides.

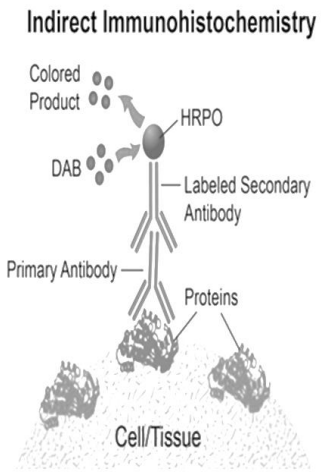
C) Ion transport and water reabsorption.

D) Synthesizing and secreting non-glycosylated proteins like enzymes.

E) Contracting to expel mucus from the lumen.

(D)

9- In 'Indirect Immunohistochemistry' (as shown), what is the specific role of the 'Labeled Secondary Antibody'?



A) It binds directly to the target protein in the tissue.

B) It catalyzes the formation of mucin granules.

C) It is a fluorescent tag that binds to the cell membrane.

D) It acts as a contractile element to propel secretions.

E) It carries a signal-generating label (like HRPO) and binds to the primary antibody.

(E)

10- Which of the following describes the 'Apocrine' method of secretion as seen in mammary glands?

A) Disintegration of the entire cell to release lipid droplets.

B) Transport of secretory granules via gap junctions between cells.

C) Secretion of hormones directly into the basal lamina capillaries.

D) Pinching off the apical portion of the cell containing the product.

E) Release of contents via simple exocytosis of vesicles.

(D)