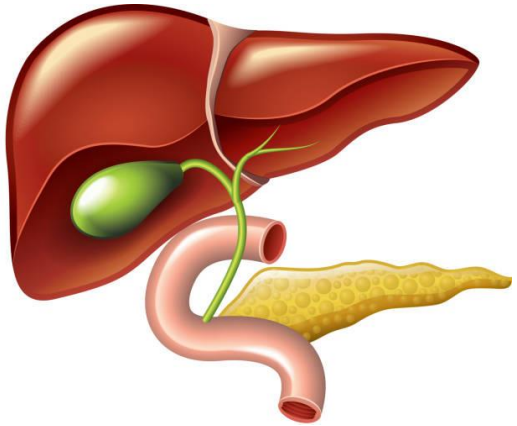
Ashur University
College of Medicine

Grade 2
PHYSIOLOGY OF
GASTROINTESTINAL TRACT
(GIT)
Lec. 8

Regulation of biliary secretion, Small & Large Intestinal Secretions



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Objectives:

- Describe regulation of biliary secretion.
- Describe the Small intestinal secretions.
- Outline the effects of intestinal bacteria.

REGULATION OF BILIARY SECRETION

- **Bile is continually secreted** from the cells of the liver into hepatic ducts and stored in gallbladder(GB) until it is needed in the duodenum.
- **In Gallbladder Bile is normally concentrated about 5- fold**, but it can be concentrated up to a maximum of 20- fold.
- **Substances which increase the secretion of bile from liver are known as choleretics.**
- **The most effective choleretics are:**

  1-Bile salts

  2-Vagal stimulation

  3-Secretin

1-Bile salts:

They are the **most important choleretic** substance. The amount of bile salts secretion is controlled by the concentration of bile salts in the blood. **The greater the plasma concentration of bile salts, the greater is the stimulus for their secretion**.

Thus between meals when there is little bile salts in the intestine and little absorbed , the plasma concentration of bile salts is low and there is little bile salts available to be transported into the bile ducts i.e. the enterohepatic cycling of bile salts is minimal.

During a meal the higher plasma concentration of absorbed bile salts leads to an increased rate of bile salts secretion.

2- Vagal stimulation: Parasympathetic stimulation via the vagus nerve increases bile secretion.

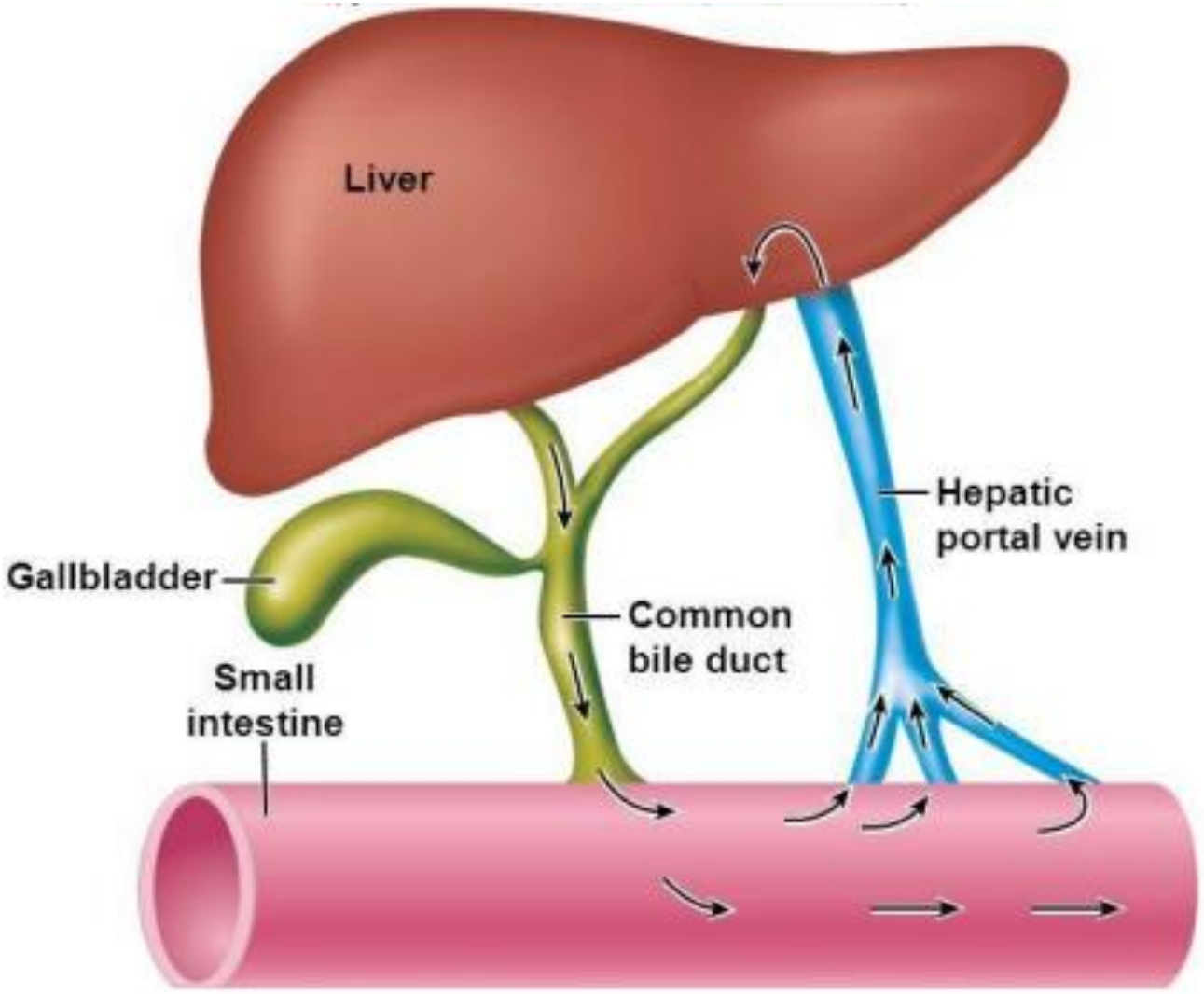
3- Secretin: increases the bile secretion.

This increase in secretion consists almost entirely of **secretion of a sodium bicarbonate–rich watery solution** by the epithelial cells of the bile ductules and ducts and does not represent increased secretion by the liver parenchymal cells. The bicarbonate in turn passes into the small intestine and **joins the bicarbonate from the pancreas in neutralizing the hydrochloric acid from the stomach.**

Enterohepatic circulation of bile salt

Enterohepatic circulation :

denotes the movement of bile acid molecules from the liver to the small intestine and back to the liver.



Control of gall bladder Contraction and emptying

- Substances that cause contraction of the gall bladder and expulsion of bile from the gall bladder are called **CHOLAGOGUES , for example CCK**.

  The contraction of gall bladder is under control of **two types of control**:

1- Nervous (Neural)

2- Hormonal

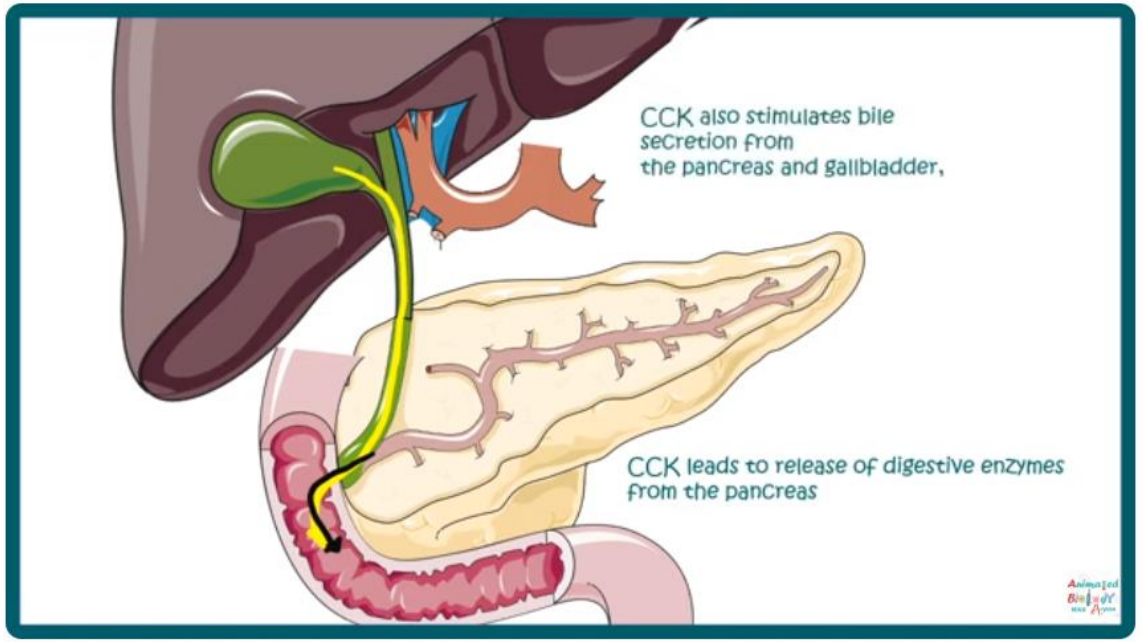
Neural : By **parasympathetic stimulation via the vagus nerve** which causes contraction of the gall bladder and relaxation of the sphincter of Oddi.

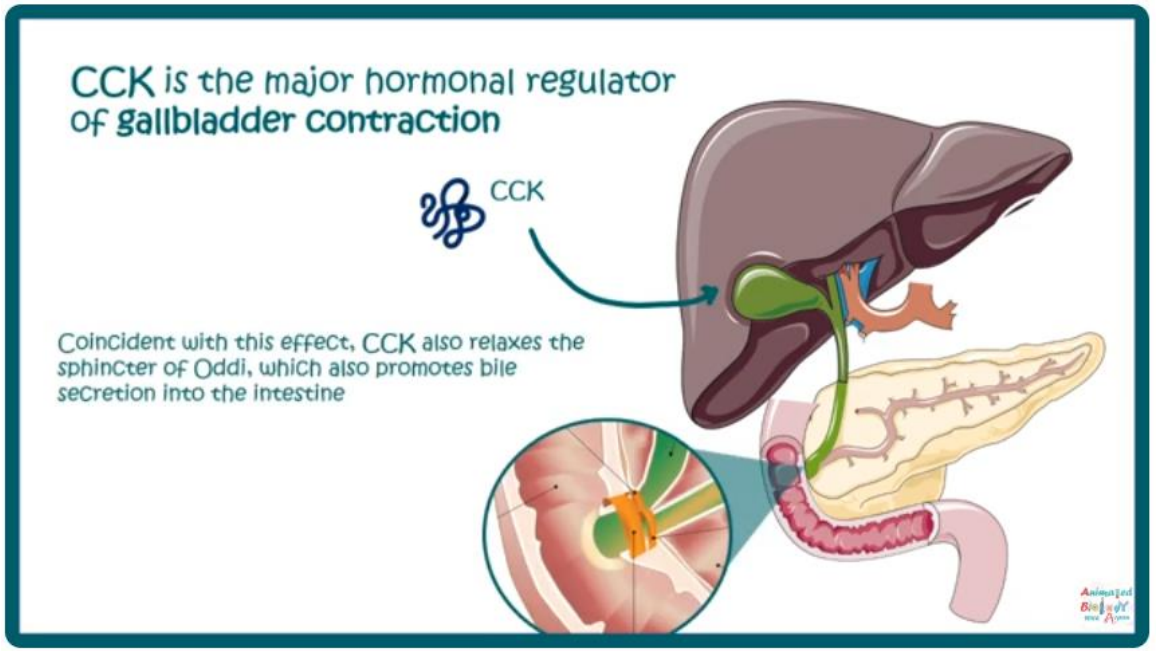
Hormonal mechanism :

The hormonal mechanism is more important.

CCK is secreted from the duodenal mucosa in response mainly to fat and byproducts of protein digestion such as proteases and peptones and to a lesser extent to acid.

CCK will be absorbed to the blood then to the gall bladder and will **cause emptying of the gall bladder (contraction of the gall bladder and relaxation of the sphincter of Oddi).**





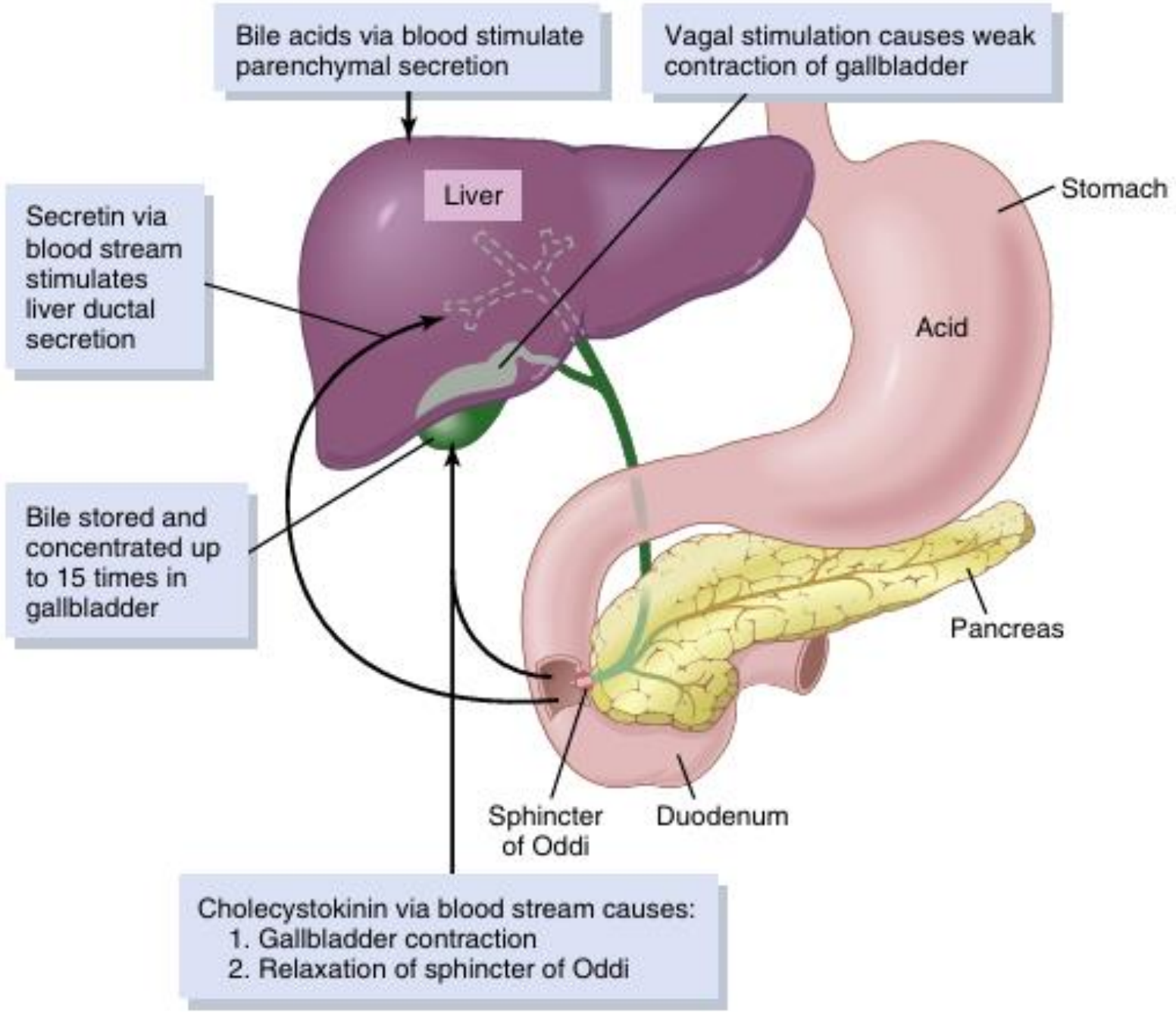
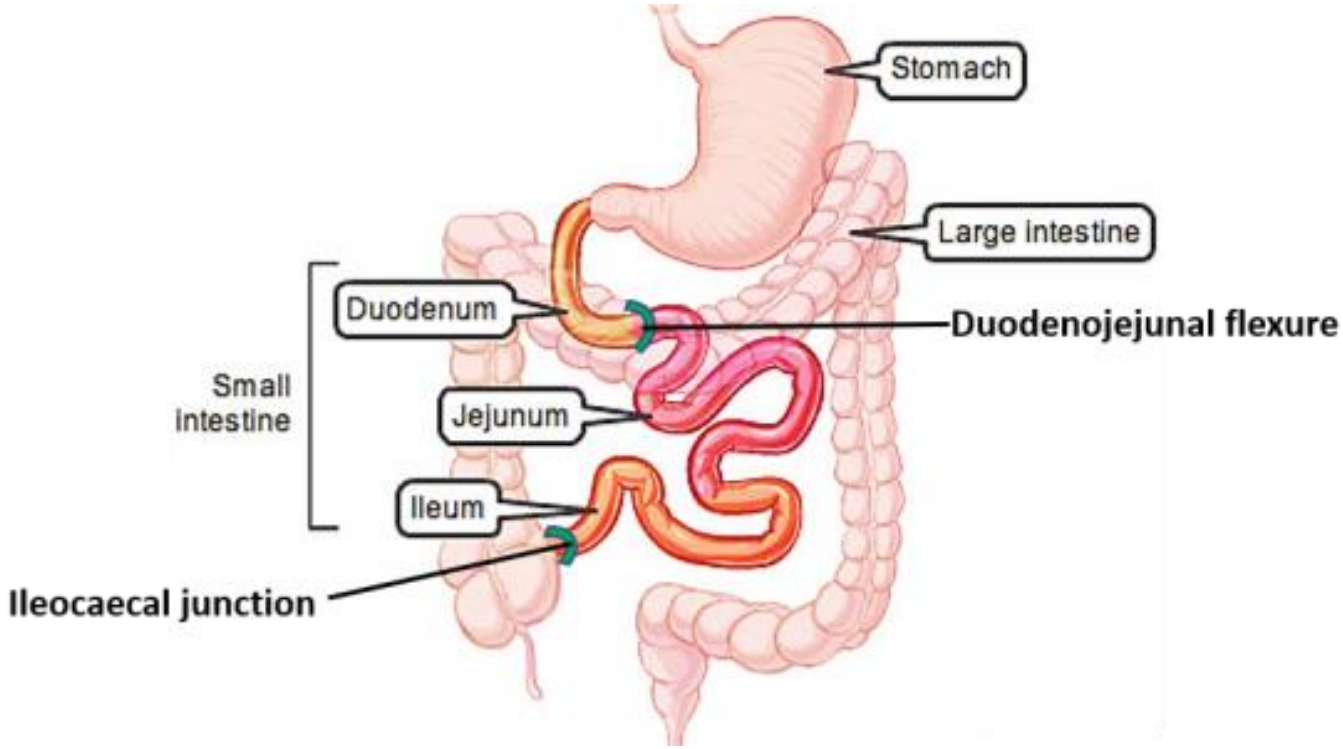


Figure : Liver secretion and gall bladder emptying

SMALL INTESTINE

- The small intestine consists of the **duodenum, jejunum, and ileum**.
- The small intestine is the major site for digestion and absorption. Within the small intestine the hydrolysis of every major type of food molecules is completed and the resulting smaller molecules are absorbed into the circulating blood or lymph.



- We have two types of glandular secretions in the small intestine:

– **Brunner’s gland secretion.**

– **Crypts of Lieberkühn secretion**

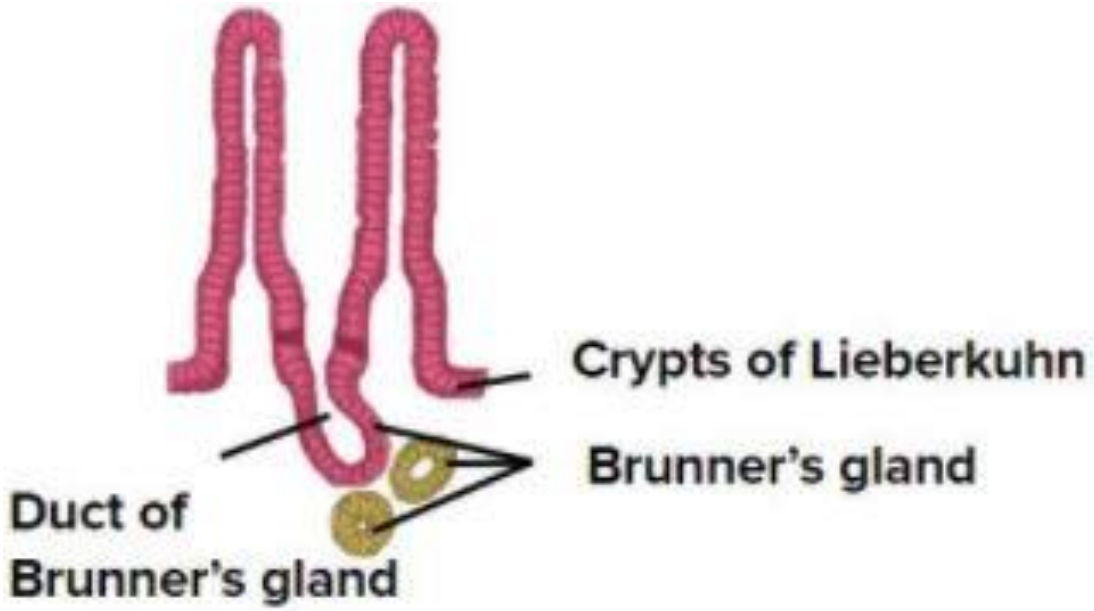


Fig. Brunner’s gland

Small intestinal secretions

- **Brunner's glands**, is located in the wall of the first few centimeters of the duodenum between the pylorus of the stomach and the papilla of Vater, where pancreatic secretion and bile empty into the duodenum.
- These glands **secrete large amounts of alkaline mucus** in response to the following:

(1) Tactile or irritating stimuli on the duodenal mucosa;

(2) Vagal stimulation, which causes increased Brunner gland secretion concurrently with increase in stomach secretion

(3) Gastrointestinal hormones, especially secretin.

- **Brunner’s gland secrete special type of mucus which is thick, viscid, alkaline** and helps in protecting the duodenum against the acid chyme emptied by the stomach.
- In addition, **the mucus contains a large excess of HCO_3^-**, which add to the HCO_3^- from pancreatic secretion and liver bile in neutralizing the hydrochloric acid entering the duodenum from the stomach.

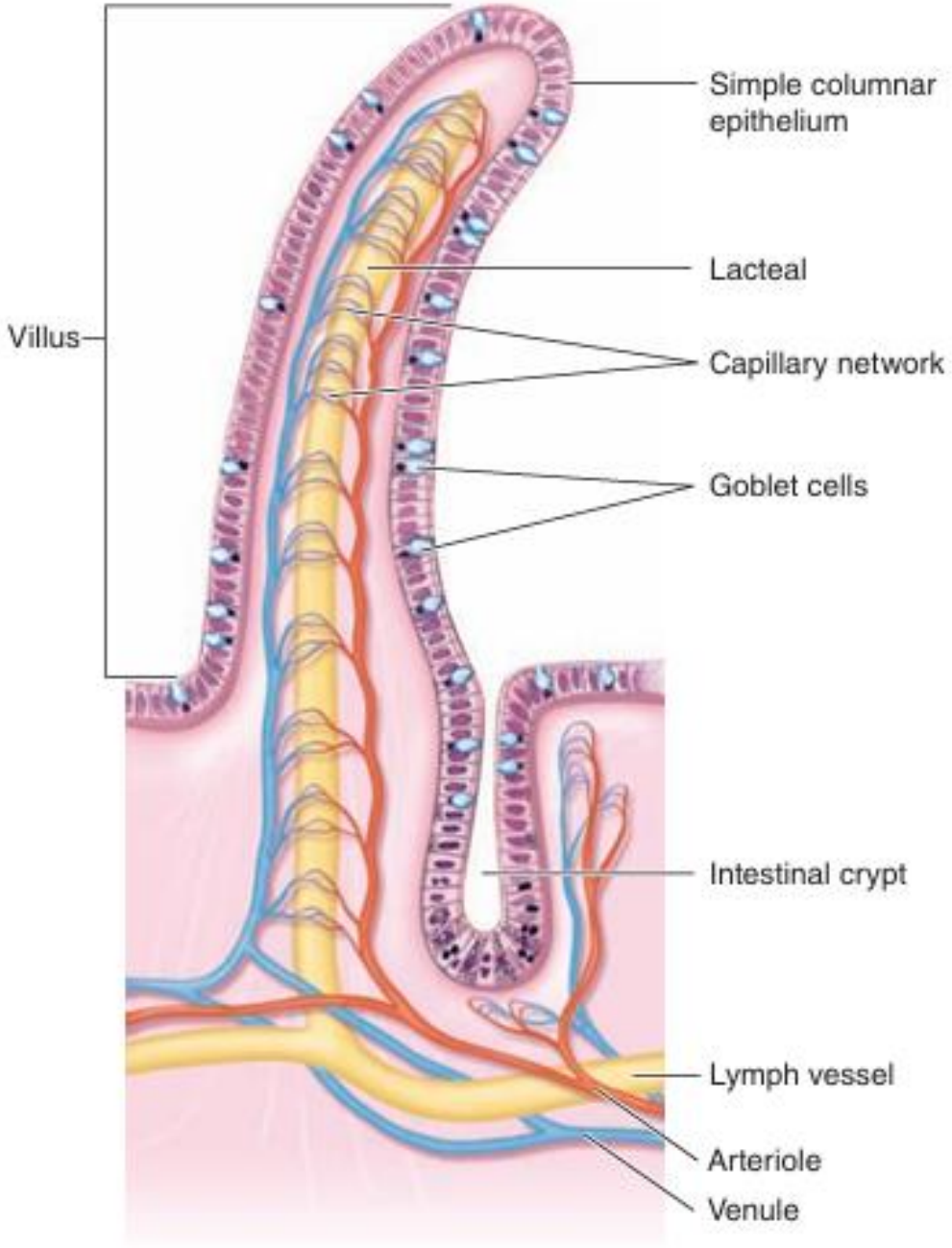


FIGURE:

The structure of intestinal villi and crypts

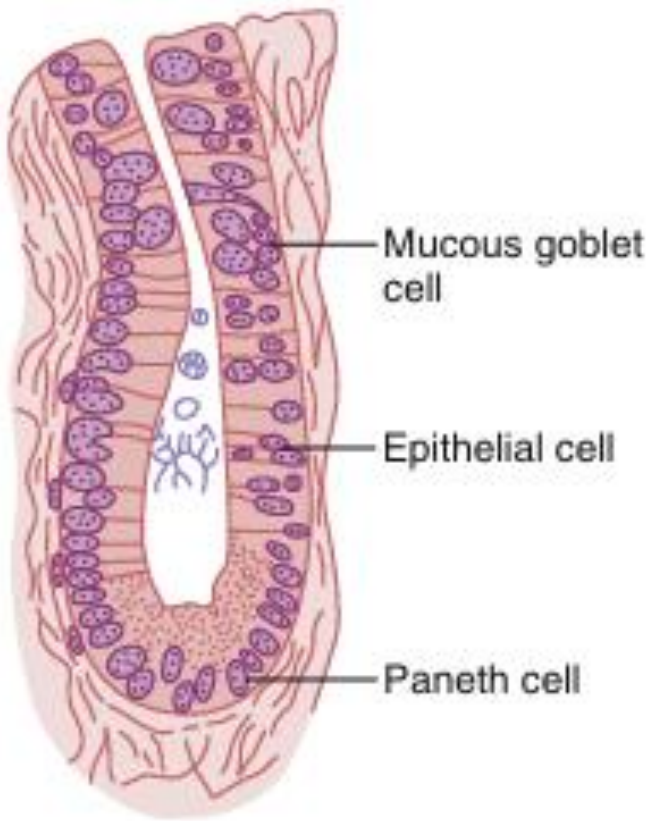
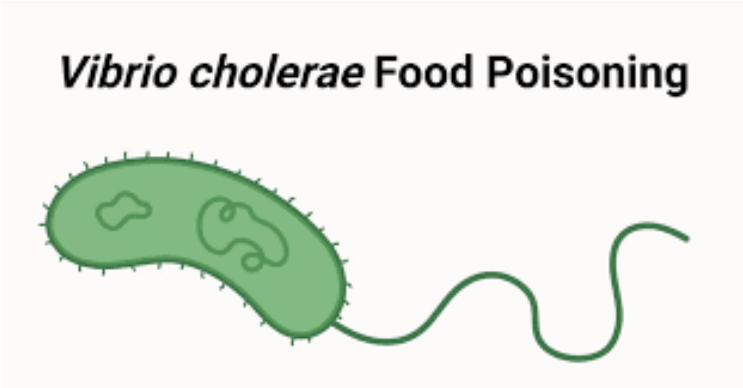


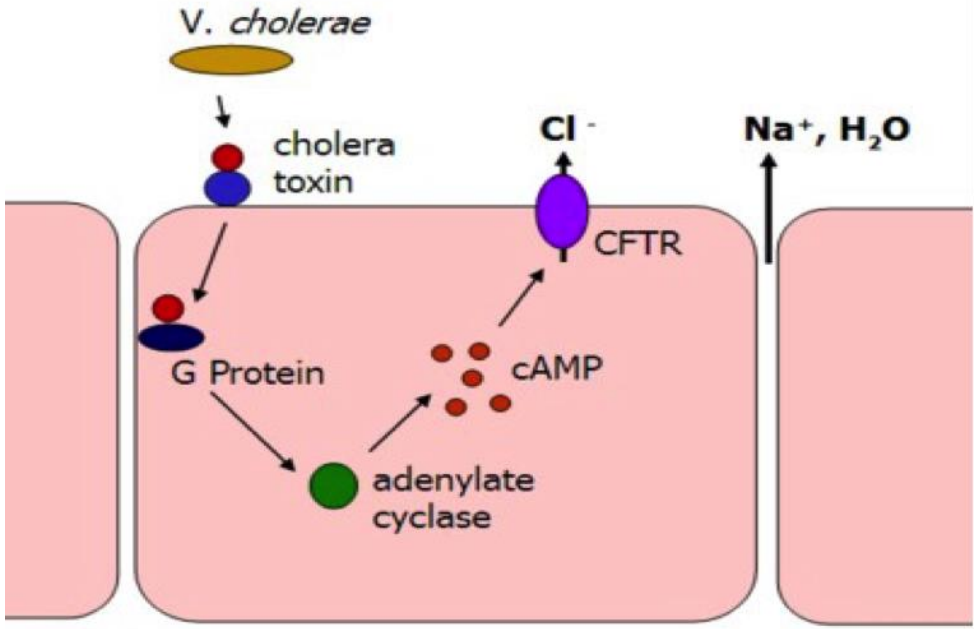
Figure: A crypt of Lieberkühn, found in all parts of the small intestine between the villi, which secretes almost pure extracellular fluid.

Clinical point





Cholera toxin seems to have a specific effect in increasing active transport of Cl^- ions into the crypts. This will lead to **massive loss of fluid into the intestinal tract.**



REGULATION OF SECRETION OF THE SMALL INTESTINE

Local Stimuli :

The most important means for regulating small intestine secretion are local enteric nervous reflexes, especially reflexes initiated by tactile or irritative stimuli from the chyme in the intestines. Stimuli are :

A-Tactile

B-Irritative

C-Distension.

Vagal stimulation has probably No effect on intestinal glands.

- **Hormonal regulation:**

hormones that increase secretion in other parts of the gastrointestinal tract will increase the small intestinal secretion of these hormones:

A- Secretin

B- CCK

C- VIP (vasoactive intestinal polypeptide).

LARGE INTESTINE

- **The main function of the large intestine is**

  ① Absorb water and electrolytes from the chyme.

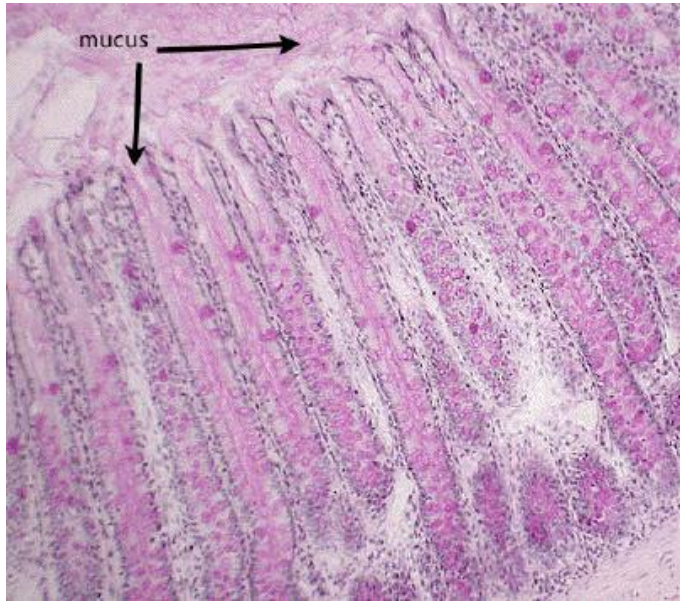
  ② Store the faecal matter until it can be expelled by defecation.

The mucosa of the large intestine contains No villi.

There are **crypts of Lieberkühn** but they are composed largely of **goblet cells that secrete mucus**. Also there are **no enzymes in the epithelial cells.**

Thus the most important secretion in the large intestine is mucus .





The main functions of mucus secreted by the large intestine are:

1. Provide an adherent medium to hold the faecal mass together.

2. Protect the mucosa against excoriation or damage, against bacterial activity inside the faecal mass, against the acid formed deep in the faeces (PH 8 caused by large amount of sodium bicarbonate in colonic secretion) and thus neutralize the acid formed by the bacterial activity in the large intestine.

REGULATION OF SECRETION OF THE LARGE INTESTINE:

- **Direct tactile stimulation of the goblet cells**.
- **Local nerve reflexes through the intrinsic nerve plexus** to the goblet cells.
- **Parasympathetic nerve stimulation through stimulation of Nervi erigentes (pelvic nerve)** will cause marked increase in mucus secretion and also it causes an increase in motility. Therefore during excessive parasympathetic stimulation such as **after emotional stress** there might be frequent bowel motions with a large amount of ropy mucous quality→ **psychogenic or emotional diarrhea.**

Large intestinal bacteria

The large intestine of the newborn child is bacteriologically sterile. This sterility will last for a few days only and thereafter the intestine will be invaded and colonized by ingested bacteria. The bacteria will flourish mainly in the large intestine, while the small intestine contains much less bacteria. **The reasons why the small intestine contains less bacteria than the large intestine might be due to:**

1. Acid gastric secretion.

2. Rapid transit time in the small intestine will allow less time for the growth of bacteria

Effect of intestinal bacteria :

Intestinal bacteria have a complex effect on their host (man).

Some of these effects are useful and others are harmful:

- **Antibiotics** improve growth rates in a variety of species including man, that's the reason why antibiotics are frequently added to the diets of domestic animals.
- **Nutritionally important substances** such as **vitamin C** and **cyanocobalamine (Vit. B12)** and **choline** are utilized by some intestinal bacteria. On the other hand **some bacteria synthesize vitamin K** and some **B-complex vitamin**. **Folic acid** was shown to be absorbed in significant amounts.
- Intestinal bacteria **form a number of amines** such as indole skatole, which contribute to the odor of the faeces, as do sulfides.
- **Change primary bile acids in to secondary bile acids**.

- **Partly responsible for the formation of gases in the large intestine** .the amount of gases entering or forming in the large intestine each day is about 7– 10 liters where as the average amount expelled is only 0.6 liters. The reminder is absorbed through the intestinal mucosa. Most often the person expels large amount of gases not because of excessive bacterial activity but because of excessive motility of the large intestine, the gases being moved on through the large intestine before they can be absorbed.
- Intestinal bacteria appear to **play a role in cholesterol metabolism**, since the poorly absorbed antibiotic neomycin that modifies the intestinal flora lowers plasma LDL and cholesterol levels.

- **Colonic bacteria produce Short Chain Fatty Acids (SCFA)** by acting on undigested complex carbohydrates from fruits and vegetables, and the major site of their production and absorption is the colon. They appear to be trophic to the colonic mucosa and they promote the absorption of Na^+ by Na^+ SCFA coupled absorption.
- **SCFAs** when absorbed will be metabolized and make a **significant contribution to the total caloric intake.**

SCFAs combat inflammation.

SCFAs are absorbed in part by exchange for H^+ helping to **maintain acid– base equilibrium.**

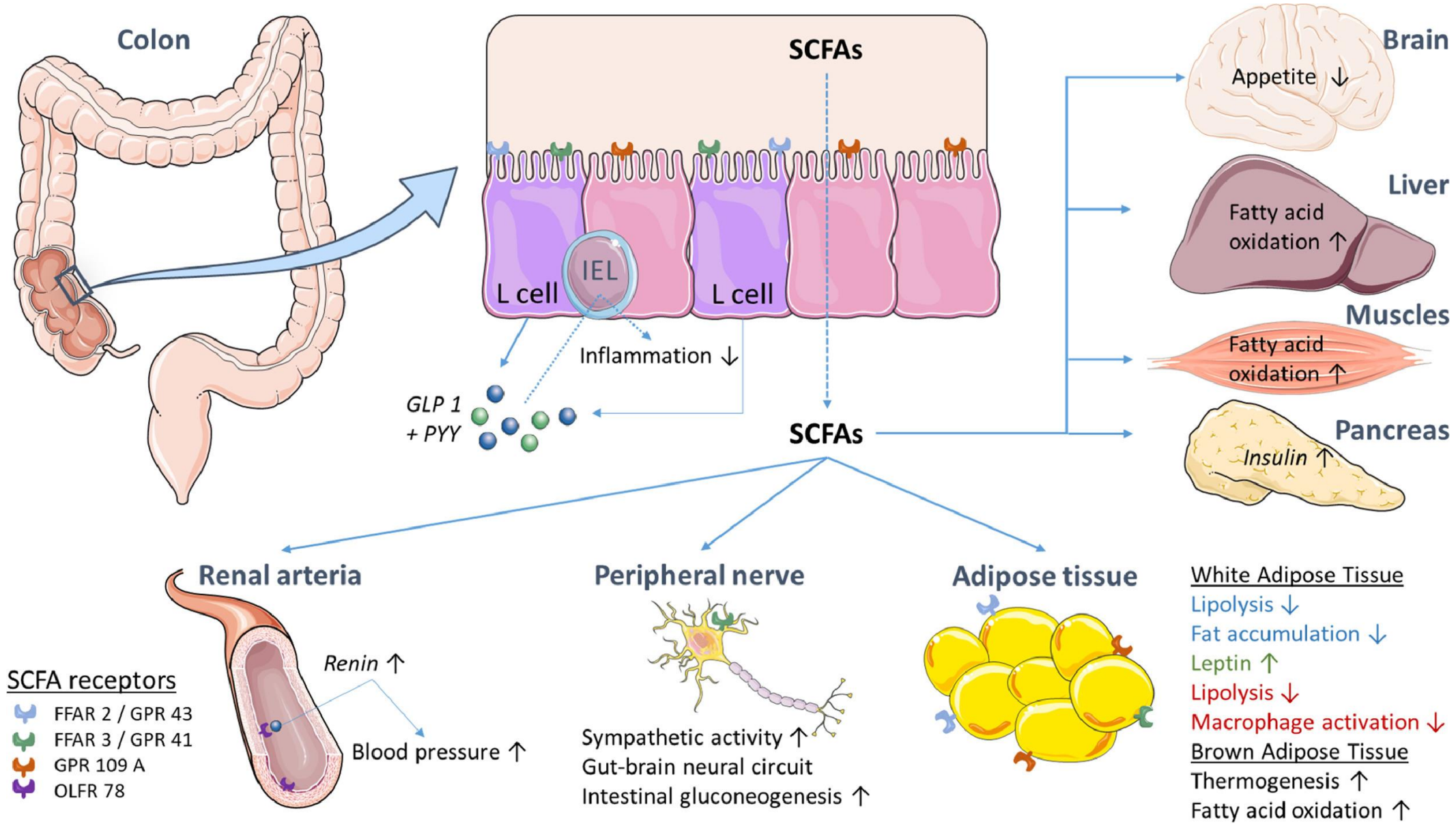


Figure :Overview of the direct and indirect effects of SCFAs on different tissues and human metabolism. FFAR= Free Fatty Acid Receptor, GLP 1=Glucagon-like receptor, GPR= G-coupled protein receptor, IEL=Intraepithelial lymphocyte, OLFR= Olfactory receptor, PYY=Peptide tyrosine tyrosine.


THANK YOU