Zydus
Medical College and Hospital

SMALL INTESTINE

Good
Morning

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SMALL INTESTINE

- Functional anatomy
- Secretions – composition, regulation , function
- Motility of SI-
    - Interdigestive period
    - Digestive period
    - Reflexes
- Function
- Applied aspect

Functional Anatomy

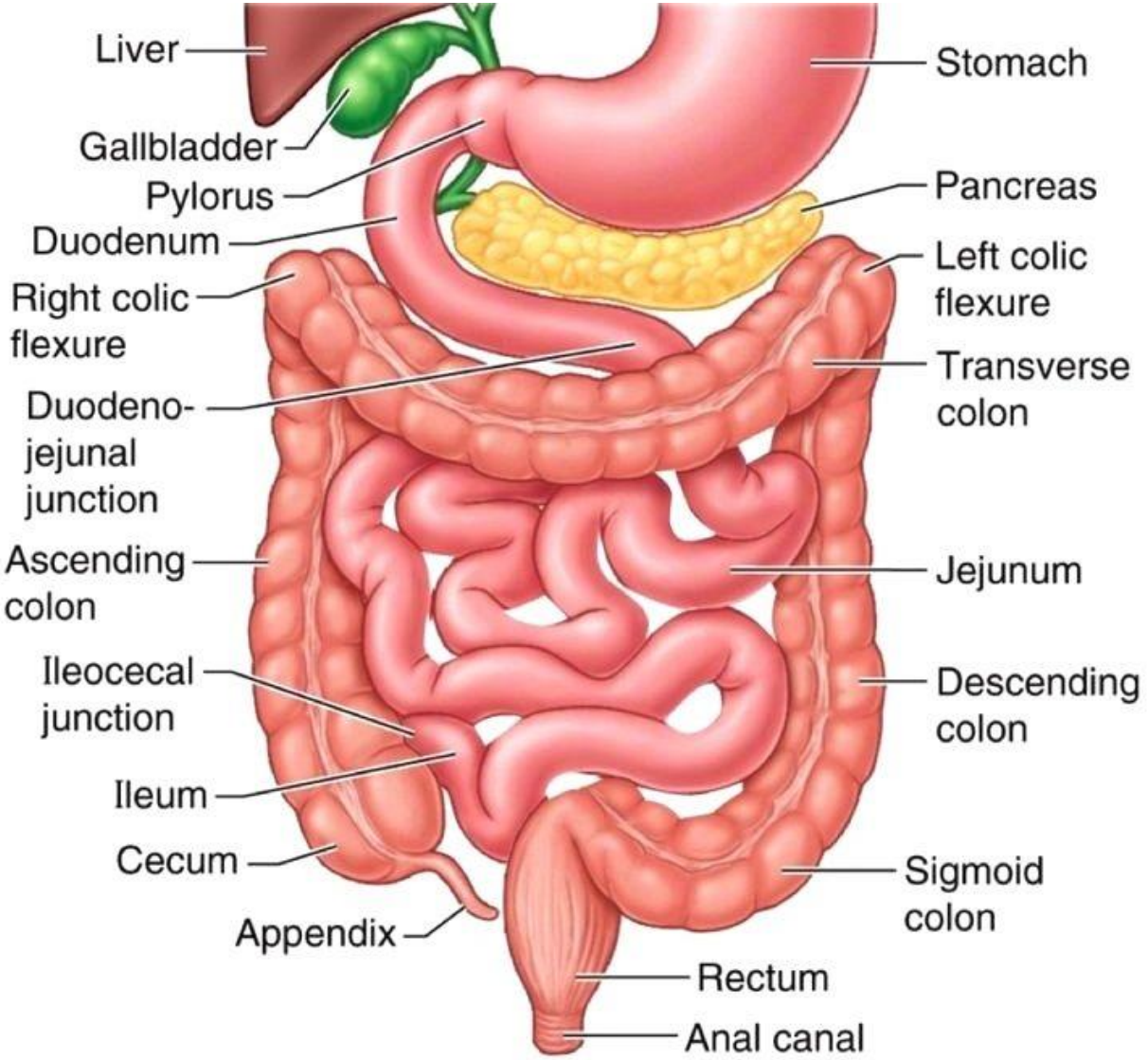
Divided into duodenum, jejunum & ileum
6 mt long and absorptive area 250m^2 ,

- **Mucosal folds - plicae circularis/valvulae conniventes - increased surface area, slow down passage of food to facilitate absorption**

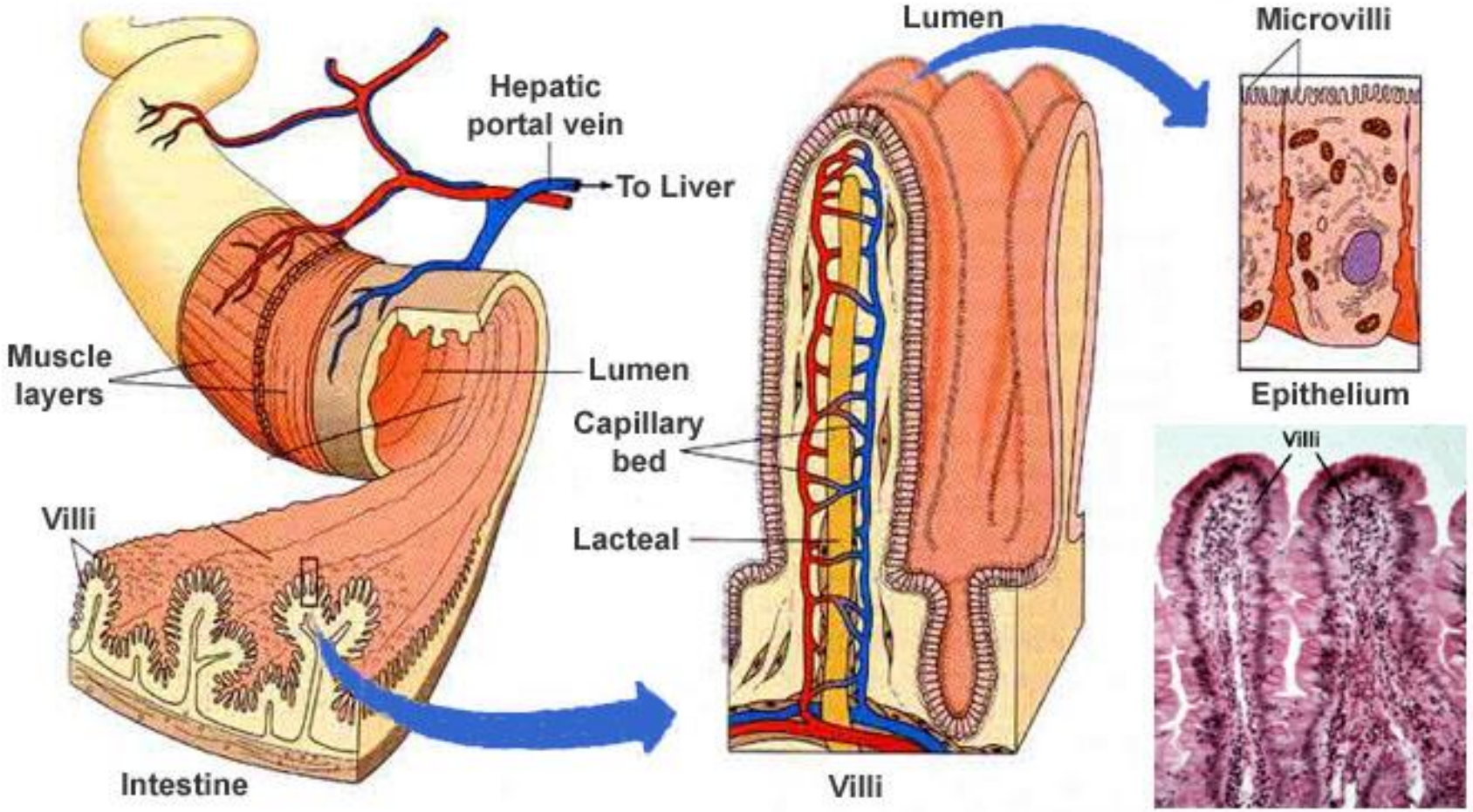
- **Villi - 0.5 - 1 mm finger like projection. Covered by columnar cells. Core contains an arteriole, venule and lymphatic vessel (lacteal), smooth muscle,nerves connected to myentric plexus**

- **Microvilli on enterocyte surface, depressions k/a crypts of lieberkuhn - tubular glands containing goblet cell, argentaffin cell, paneth cells**

Functional Anatomy contd.



Functional Anatomy contd.



Epithelial cells -

- Enterocytes - absorptive columnar
- Undifferentiated columnar cell at crypts
- Goblet cells - secrete mucus
- Argentaffin/Enterochromaffin - secrete serotonin (5-HT)
- Paneth/zymogen cells- secrete lysozyme
- Duodenal glands of Brunner - mostly near pylorus, secrete mucous and HCO_3^- - neutralizes acidic chyme

Succus Entericus

Composition

- Aqueous component (water & electrolytes)
- Intestinal Enzymes
- Mucus

Succus Entericus contd.

1) Aqueous component -

- Water and electrolytes
- 2 lit per day
- Secreted by enterocytes specially at crypts
- Composition same as ECF but Alkaline (pH = 7.5-8.6)
- Function - solvent

Succus Entericus contd.

2) Intestinal Enzymes -

- **Peptidases -** split peptides to amino acid e.g. aminopeptidases, dipeptidases, nuclease
- **Disaccharidases** - split sucrase, maltase, lactase to monosaccharides
- **Intestinal Lipases -** split triglycerides
- **Enterokinase -** activates trypsiogen

Succus Entericus contd.

3) Mucus secreted by

Brunner's glands - secrete alkaline mucus - prevents acidic chyme from damaging duodenal mucosa

Goblet cells - secrete mucus and lubricate chyme

Succus Entericus

Composition

- Aqueous component (water & electrolytes)
- Intestinal Enzymes
- Mucus

Succus Entericus contd.

Regulation of secretion

- **Local stimuli** - mechanical distension/irritation of intestinal mucosa - increase secretion- via myentric reflexes -
- **Vasoactive Intestinal Peptide (VIP)** - secreted by crypts - increases secretion
- Secretion of **Brunner's glands** increased by -
  - Vagal stimulation
  - Mechanical stimulation/irritation of duodenal mucosa
  - Secretin

Small Intestine Motility

A)Motility during interdigestive period - MMCs

B) Motility during digestive period -

- **Mixing movements**

  a) Segmentation contractions b) Pendular movements

- **Propulsive movements**

  a) Peristaltic contraction b) Peristaltic rush

- **Movements of Villi**

C) Reflexes

a) Gastroileal reflex b)Intestinointestinal reflex

A) INTERDIGESTIVE PERIOD MOTILITY- MMC

- Wave begin in oesophagus and travel through entire GIT during interdigestive period.
- Occur every 60-90 min last for 10 min
- Close correlation BER and MMC
- Increase in gastric secretion, bile flow and pancreatic secretion.
- Interdigestive housekeeper
- Motilin increases strength of MMC
- Ends with food entry in stomach

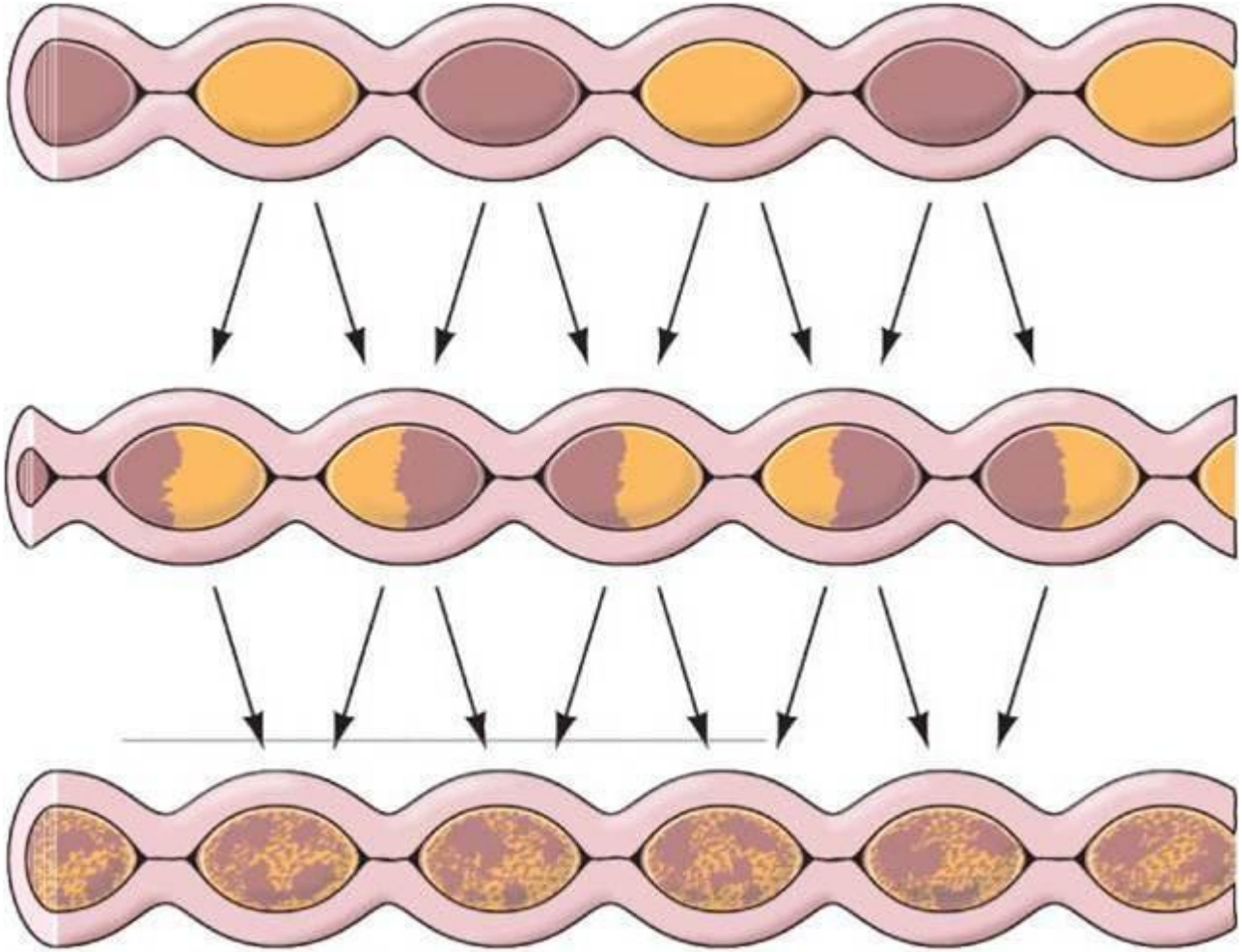
- **B) MOTILITY DURING DIGESTIVE PERIOD**

I) Mixing movement-

a) Segmentation contractions -

- Rhythmic & occurs throughout digestion
- Section of intestine contracts (2-5cm) sending the chyme in both directions - then relaxes bringing chyme back ,adjoining part simultaneously contracts
- Chain of sausage appearance
- Rate is 12/min in duodenum, 8/min in ileum
- Produces thorough mixing

Small Intestine Motility contd.



TYPES-

- Eccentric contractions – less than 2 mm, outer smooth muscle layer
- Concentric contraction- more than 2 mm, inner smooth muscle layer

Control-

- Initiation – membrane potential depolarization- spike- segmentation
- Pacemaker cell located in 2nd part duodenum
- Strength- proportional to frequency, amplitude of spike
- Amplitude increased by gastrin, CCK, motilin, insulin
- Amplitude decreased by secretin, glucagon

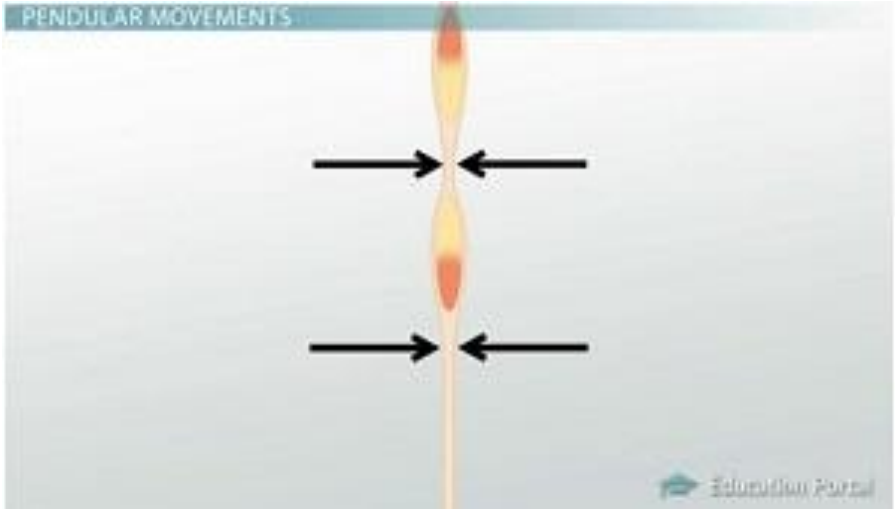
- **Function-**

- Back and forth movement of chyme= through mixing
- Slow down transit time in small intestine, increase contact time for absorption

Small Intestine Motility contd.

b) **Pendular Movements**

Small constricting waves which move forwards & backwards or upwards & downwards



II) PROPULSIVE MOVEMENT

Pushing chyme towards aboral end of intestine.

a) Peristaltic contraction -

- Contraction behind the bolus and relaxation ahead
- Vermiform movements- 0.5 cm/sec, chyme moves 1cm/min
- Follow **law of gut-** wave travel from oral end to aboral end.
- Polarity of intestine/ polar conduction of intestine/electrical activity of intestine/theory of receptive relaxation- **Starling**

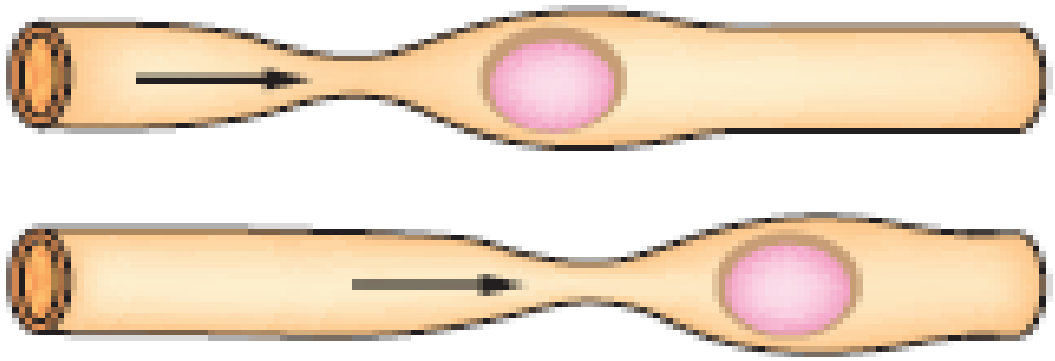


Fig. 7.5-5 Peristaltic contraction moves the food through intestine by pushing bolus ahead of muscle contraction.

FUNCTION-

- Help in propulsion, digestion and absorption of food
- Executed by myentric plexus - stretch releases serotonin - myentric plexus - ACh, substance P cause contraction behind & NO, VIP, ATP cause relaxation ahead of bolus.

CONTROL

- Stimulus- distention
- Myentric reflex- wall stretched- wave initiated- pass to rectum 2-2.5 cm/sec. Serotonin facilitate
- Ach, Sub P- Circular contraction
- NO, VIP, ATP - Relaxation
- **Neural** - Parasympathetic increase via vagus and sympathetic decrease motility.
- **Hormonal** - Gastrin, CCK, 5-HT, thyroxine, insulin increase and secretin, glucagon decrease intestinal motility

b) Peristalstic Rush

- Powerful peristaltic contractions due to **irritation of intestinal mucosa** e.g. in infectious diarrhoea
- Start from duodenum to ileocaecal valve - sweep entire contents of small intestine into large intestine within few minutes
- Extrensic nervous reflex and myenteric reflex

III)Movements of Villi

- Alternate contraction & relaxation
- **Villikinin -** secreted by SI mucosa
- Function- Help in emptying lymph from central lacteal in lymphatic system
- During elongation of villi - surface area increases - improves absorption from lumen

C) MOTILITY REFLEX

a) Gastroileal reflex

- Distension of stomach - marked increase in peristalsis in ileum and relaxation of ileocaecal valve
- Intestinal contents delivered to large intestine
- Peristaltic contractions due to vagal stimulation
- Relaxation of ileocaecal valve due to gastrin

b) Intestinointestinal reflex

Overdistention of one segment of intestine leads to relaxation of rest of intestine

Functions of small intestine

- Mixing of food with digestive juices & propulsion
- Digestion by succus entericus, pancreatic enzymes and bile
- Absorption through portal system or lymph
- Secrete GI hormones – enterogastrones,CCK
- Enterokinase activates trypsinogen to trypsin
- Mucus protects against acidic chyme
- Aqueous part of succus entericus provide medium for digestion & absorption

Applied

Paralytic ileus/ Adynamic ileus

- Intestinal motility markedly decreased - retention of contents
- Irregular disension of small intestine by pockets of gas & fluid
- Causes - Surgery, Trauma, Peritonitis
- Symptoms - Nausea, vomiting, abdominal discomfort, abdominal distension
- Diagnosis - No bowel sounds on listening with stethoscope
- Treatment - IV fluids, antiemetics, observation

Intestinal obstruction-

- Causes- Tumor, fibrotic bands
- Symptoms- abdominal pain
- Treatment- surgery

SMALL INTESTINE SUMMARY

- Functional anatomy
- Plica circularice, folds, villi, microvilli, crypt- cells
- Secretions – composition, regulation , function
- Motility of SI-
  - Interdigestive period –MMC
  - Digestive period- MIXING, PROPULSIVE, VILLI
  - Reflexes
- Function
- Applied aspect

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