# Malabsorption: etiology, pathogenesis and evaluation

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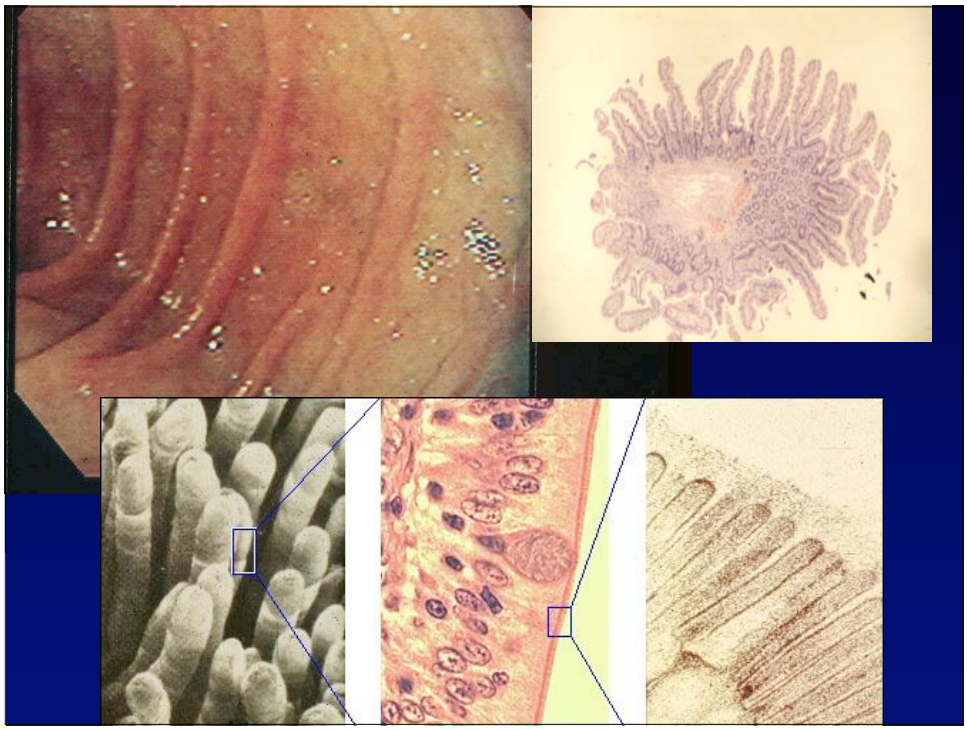
## NORMAL ABSORPTION

- Coordination of gastric, small intestinal, pancreatic and biliary function
- Multiple mechanisms
  - Fat
  - protein
  - carbohydrate
  - vitamins and minerals

# NORMAL ABSORPTION

- Integrated and coordinated response involving different organs, enzymes, hormones, transport and secretory mechanisms
- Great redundancy



# DIFFERENTIAL SITES OF ABSORPTION

- Fat, carbohydrate and protein can be absorbed along the entire length (22 feet)
- Vitamins and minerals are absorbed at different sites

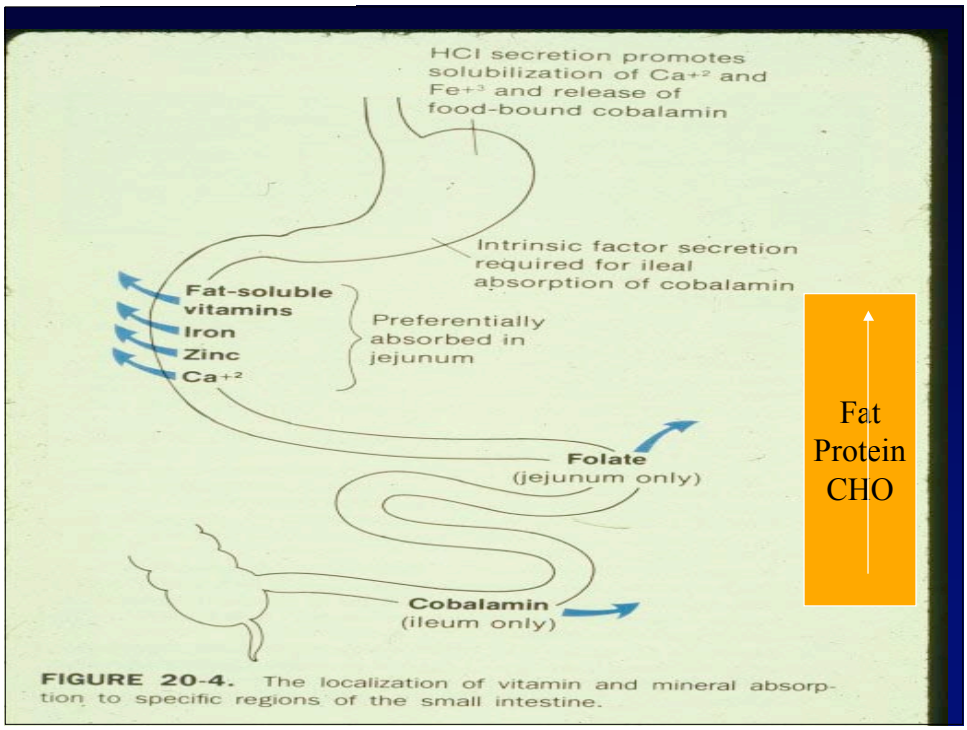
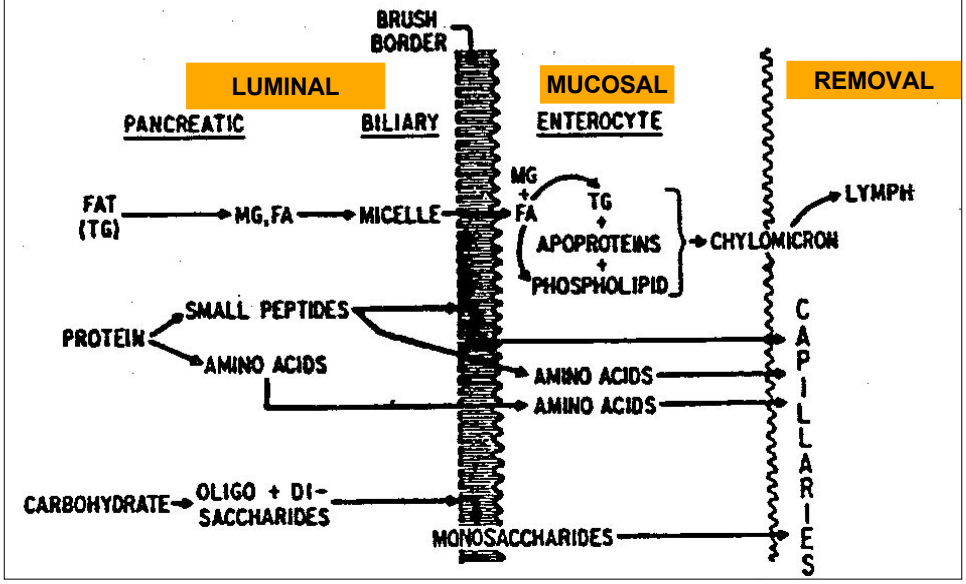



**FIGURE 20-4.** The localization of vitamin and mineral absorption to specific regions of the small intestine.

# ABSORPTION




# FAT ABSORPTION

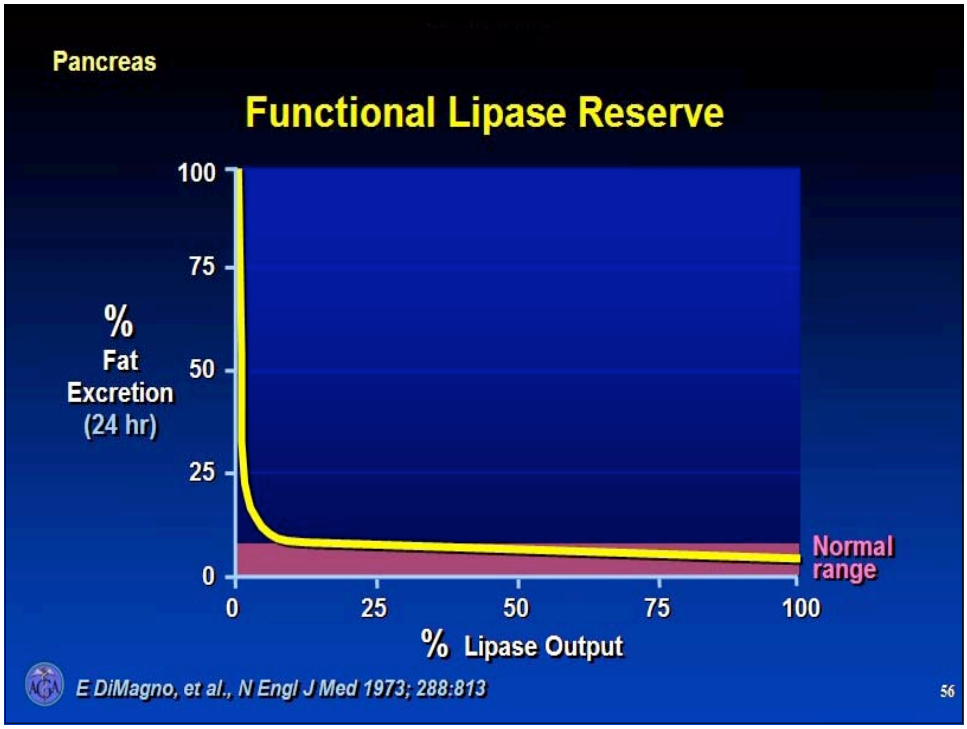
- GASTRIC PHASE
  - lingual lipase
- INTESTINAL
  - luminal
  - mucosal
  - lymphatic (delivery)

# FAT ABSORPTION

- Luminal phase
  - chyme
  - pancreatic secretion – lipase, colipase
  - micelle formation – bile salts, lecithin
- Intestinal phase
  - transport, chylomicron formation, secretion
- Transport (lymphatic) phase

# FAT MALABSORPTION

- Luminal phase
  - altered motility - chyme
  - pancreatic insufficiency - pancreatic secretion – lipase, colipase
  - micelle formation – bile salts, lecithin
- Intestinal phase
  - transport, chylomicron formation, secretion
- Transport (lymphatic) phase




# FAT MALABSORPTION

- Luminal phase

  altered motility - chyme

  pancreatic insufficiency –cancer, ductal obstruction, chronic pancreatitis

  biliary tract / liver disease – cirrhosis, bile duct cancer

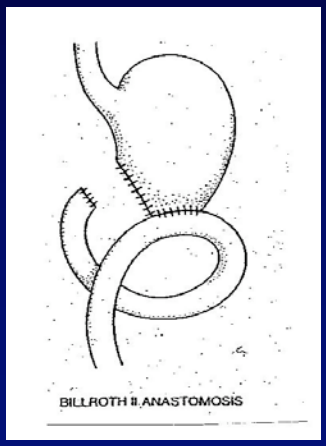
SMALL INTESTINAL BACTERIAL OVERGROWTH

## SMALL INTESTINAL BACTERIAL OVERGROWTH

BLIND LOOP SYNDROME
JEJUNAL DIVERTICULOSIS
IMPAIRED MOTILITY
(sclerthoderma, celiac disease)

Deconjugation bile salts

Rx antibiotics



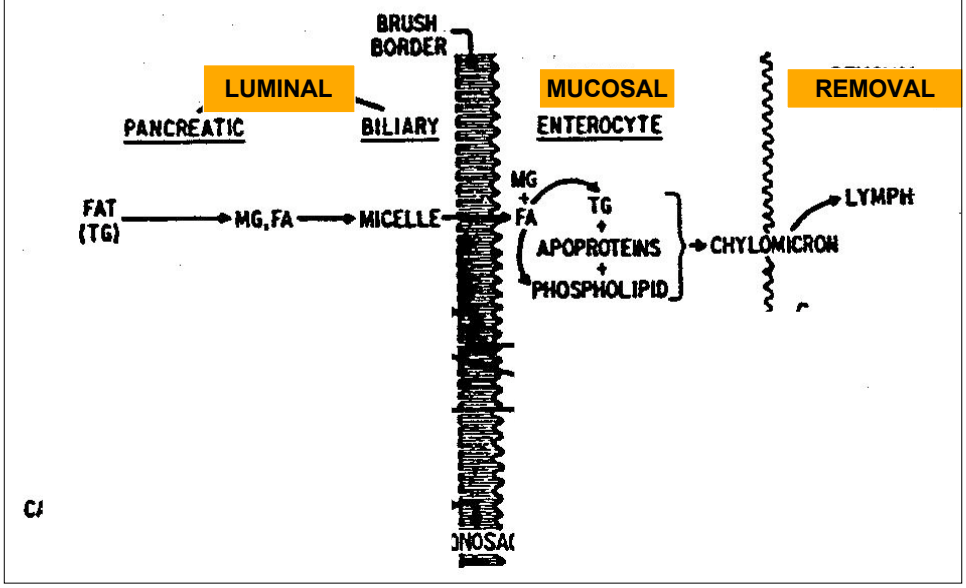

## FAT MALABSORPTION

- INTESTINAL PHASE

  mucosal disease – celiac disease, tropical sprue, Crohn's disease, radiation, abetaliporoteinemia, chylomicron retention disease, giardiasis
- REMOVAL PHASE

  Lymphatic obstruction (lymphoma)

# ABSORPTION




# FAT MALABSORPTION

- CONSEQUENCES
  - -steatorrhea, diarrhea
  - -weight loss
  - -vitamin deficiency
    - K –bleeding, A –night blindness
    - D –bone disease, E –neurological disorders

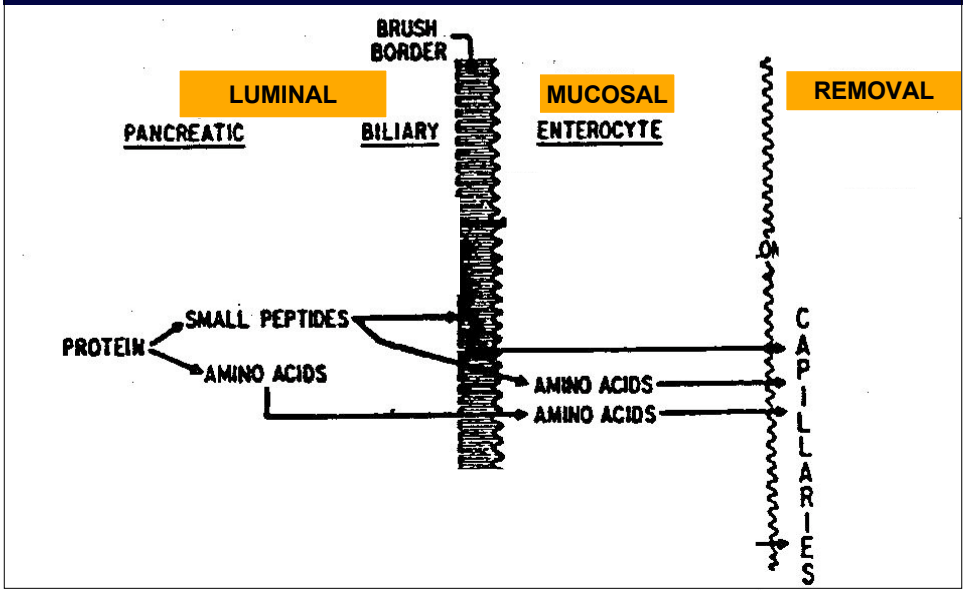
ALL, OR ONLY ONE!!

# PROTEIN ABSORPTION

- Gastric events – acid, pepsin
- Luminal events – pancreatic secretions trypsin, chymotrypsin secreted as precursors and activated by brush border enzymes, then actively transported.

- Rare congenital disorders of transport

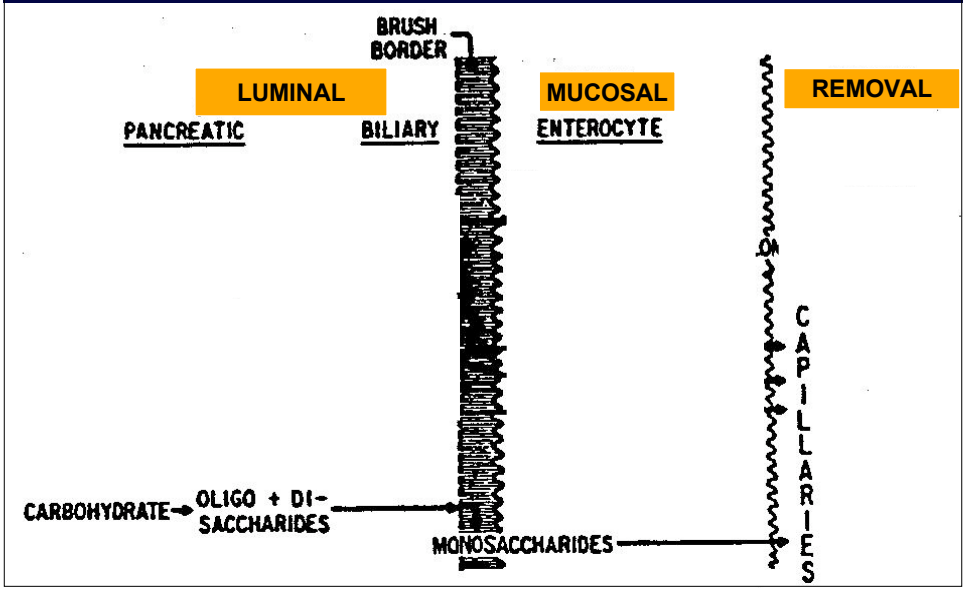
# PROTEIN ABSORPTION

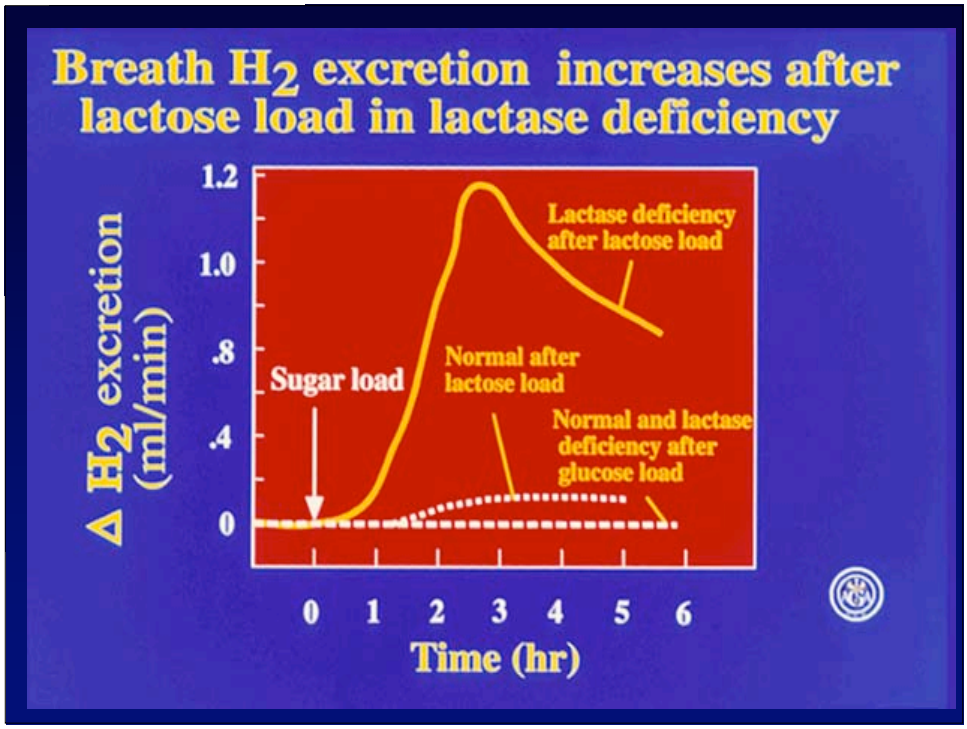


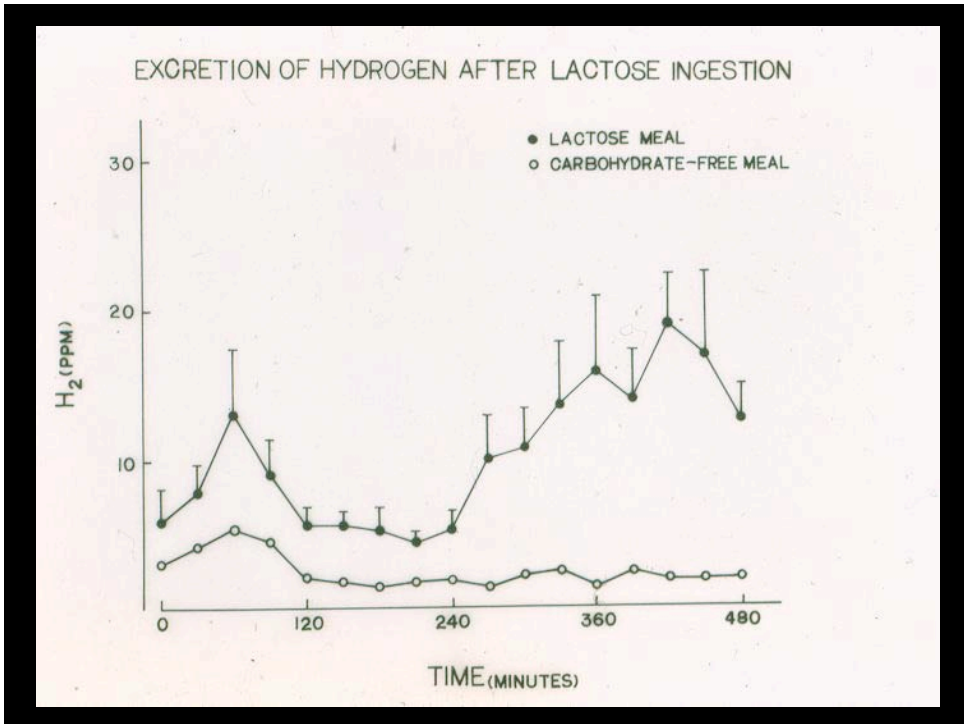
# CARBOHYDRATE ABSORPTION

- Salivary amylase
- Pancreatic amylase
  - products of digestion maltose, maltotriose, and a - dextrins, some glucose
  - glucose actively absorbed
  - brush border enzymes digest oligosaccharides (lactase, sucrase)
  - fructose malabsorption

# CARBOHYDRATE ABSORPTION

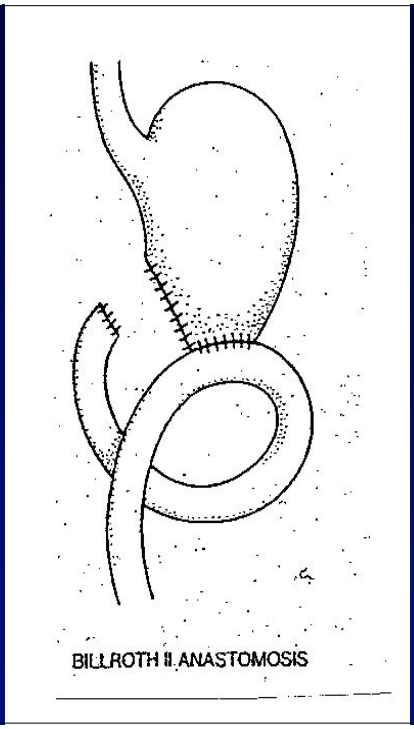



Breath $H_2$ excretion increases after lactose load in lactase deficiency
Δ $H_2$ excretion (ml/min)
1.2
1.0
.8
.4
0
Lactase deficiency after lactose load
Sugar load
Normal after lactose load
Normal and lactase deficiency after glucose load
0 1 2 3 4 5 6
Time (hr)


EXCRETION OF HYDROGEN AFTER LACTOSE INGESTION
LACTOSE MEAL
CARBOHYDRATE-FREE MEAL
$H_2$ (PPM)
30
20
10
0
120
240
360
480
TIME (MINUTES)

BLIND LOOP SYNDROME

ANTIBIOTICS



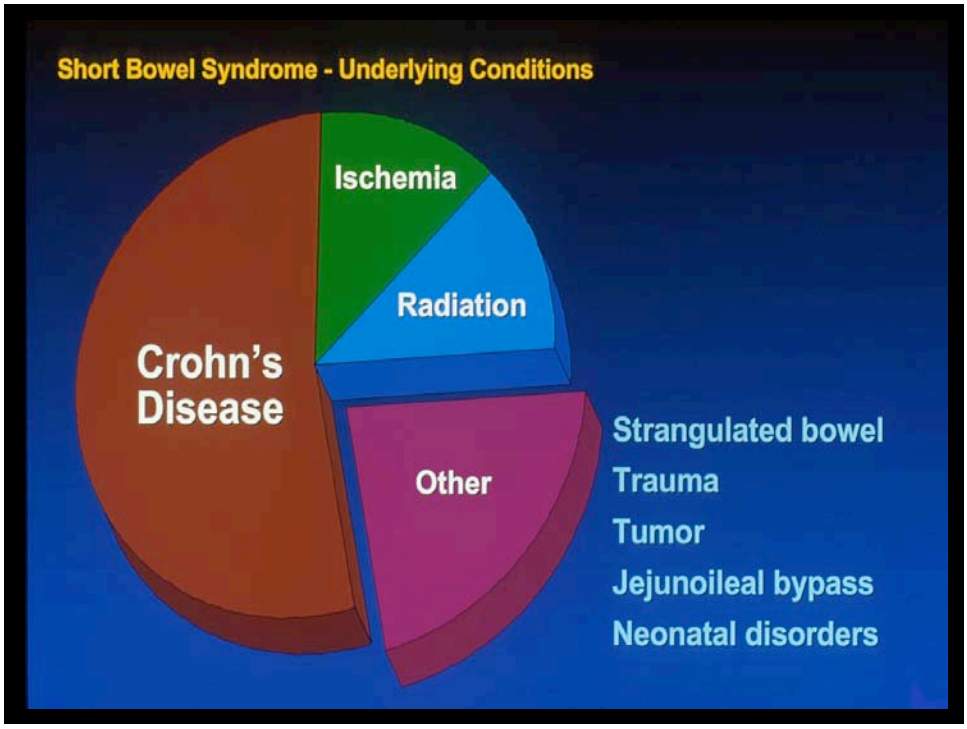

POOR MIXING
ENZYMES, CHYME

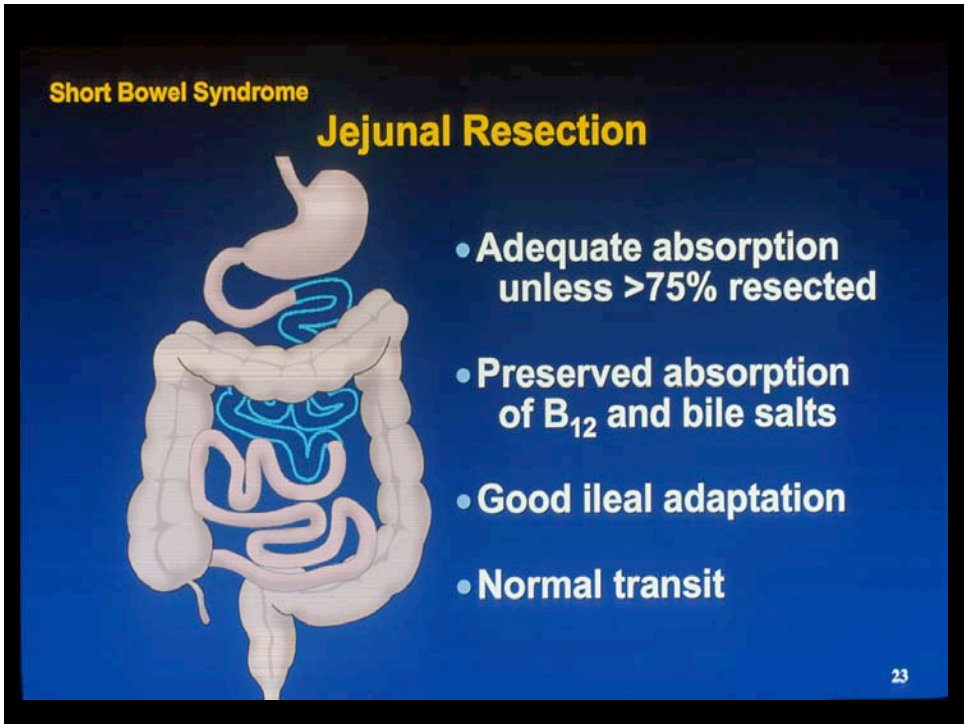
ENZYMES

## ZOLLINGER ELLISON SYNDROME

MULTIPLE MECHANISMS OF DIARRHEA AND MALABSORPTION

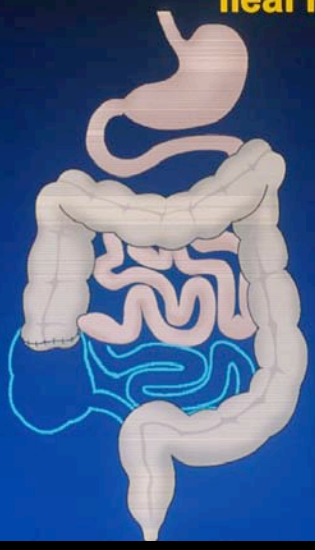
- Excessive water and acid production
- Acidification of duodenal contents, deconjugation bile salts, inactivation of enzymes
- Villous atrophy


Short Bowel Syndrome - Underlying Conditions
Ischemia
Radiation
Crohn's Disease
Other
Strangulated bowel
Trauma
Tumor
Jejunoileal bypass
Neonatal disorders


Short Bowel Syndrome
Jejunal Resection
• Adequate absorption unless >75% resected
• Preserved absorption of $B_{12}$ and bile salts
• Good ileal adaptation
• Normal transit
23

Short Bowel Syndrome

## Ileal Resection



- Adequate calorie and fluid absorption
- Malabsorption of
  - bile salts
  - vitamin $B_{12}$
- Poor jejunal adaptation
- Rapid intestinal transit

Short Bowel Syndrome

## Extensive Bowel Resection

- Large fluid losses
- Nutrient malabsorption
- Poor jejunal adaptation
- Acid hypersecretion
- Rapid gastric emptying
- Rapid intestinal transit

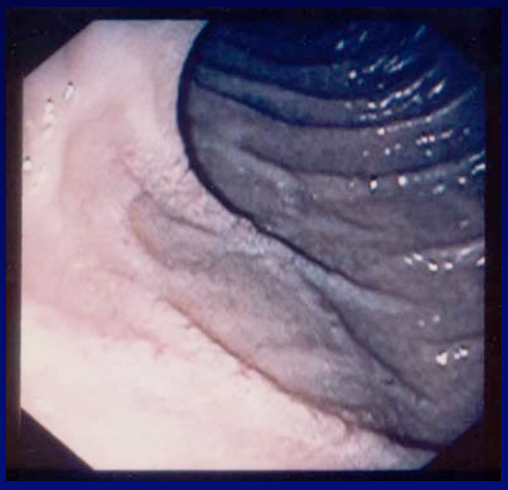
## Consequences of resection

- **Site of resection**
  - **distal bowel present**
  - **distal bowel absent**
- **Extent/severity of disease**
- **Residual disease**
- **Adaptation of residual intestine**
- **Age**

## MALABSORPTION DUE TO INFECTIONS

- Giardiasis
- Cryptosporidiasis
- Strongyloides
- Isospora
- Mycobacterium avium

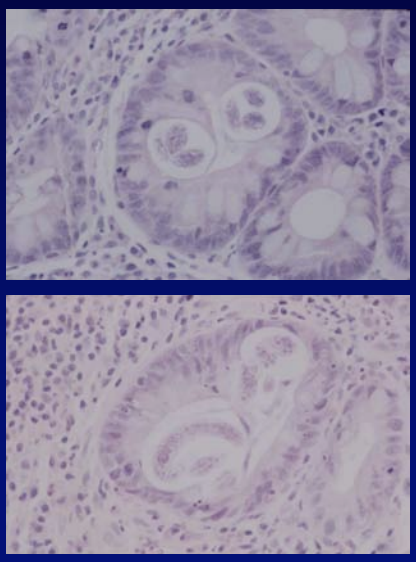
## Upper Endoscopy
## Strongyloides



## Upper Endoscopy

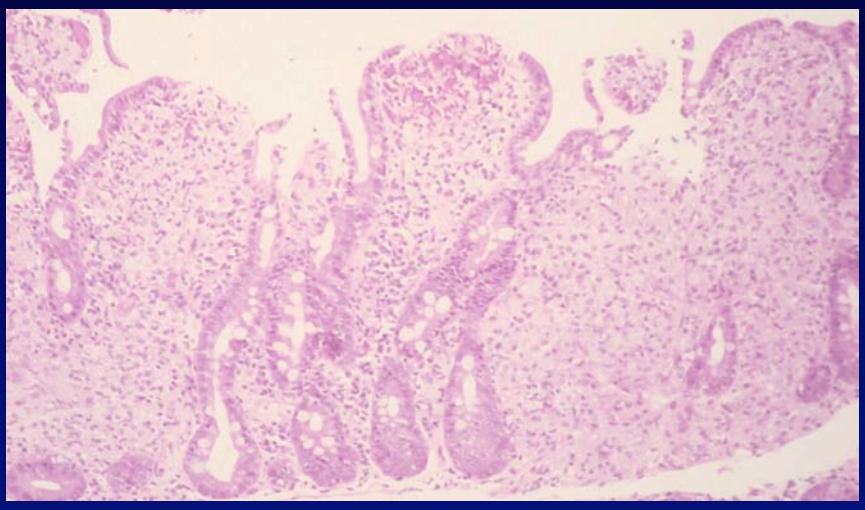
## Upper GI Series

## Histology – Strongyloides Stercoralis



## *Isospora belli*

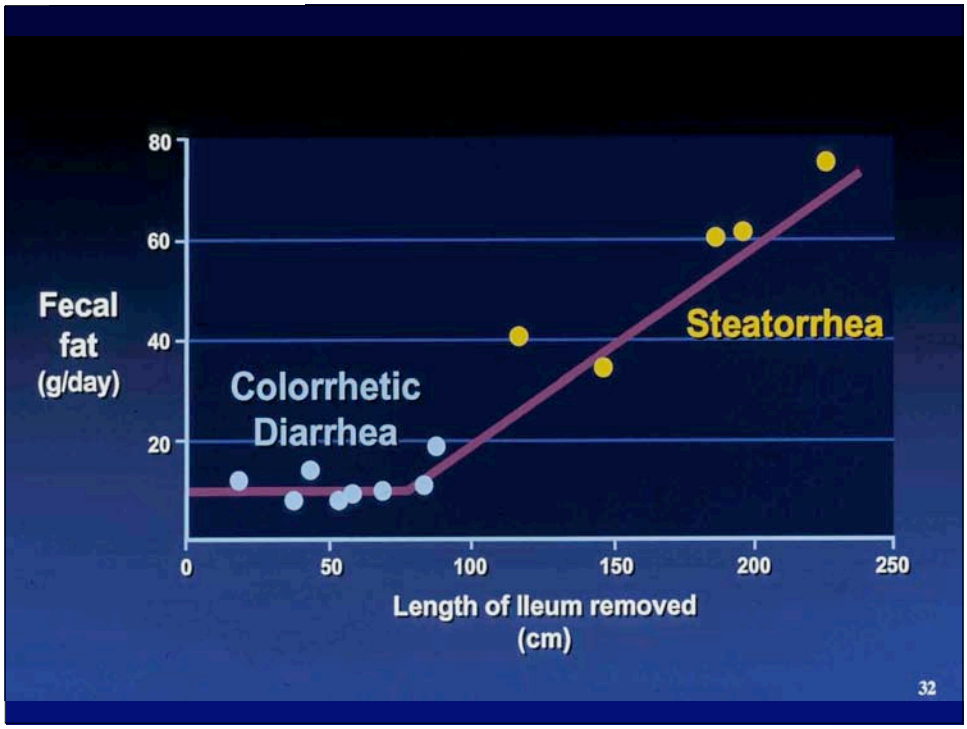
## *Mycobacterium avium*



Malabsorption due to ileal disease/resection

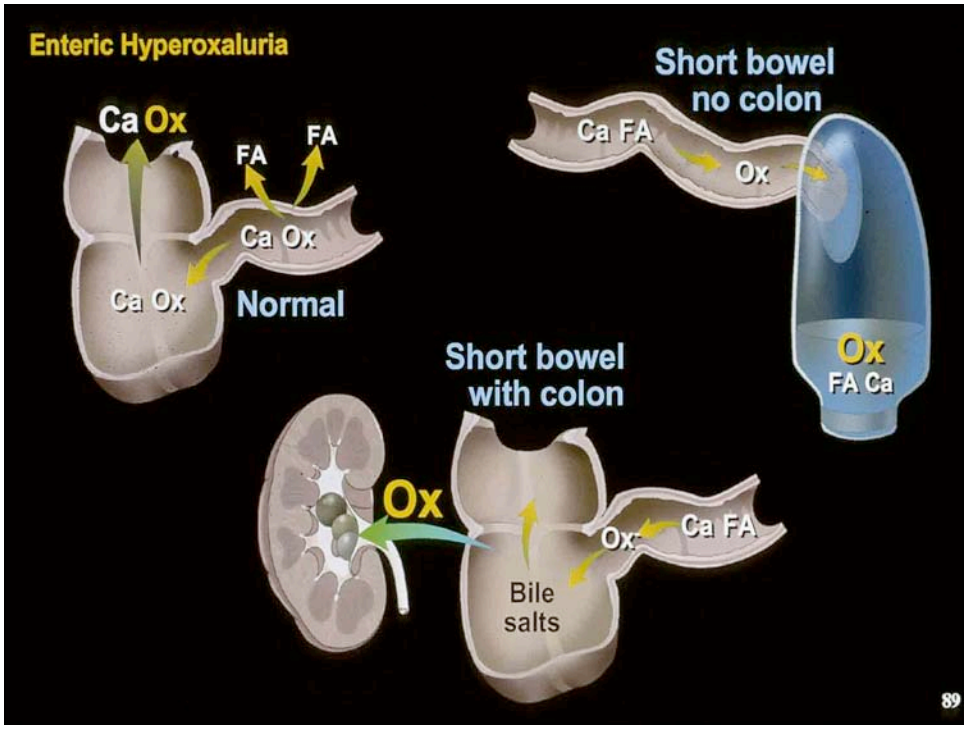
## Crohn's ileitis

**MALABSORPTION**
**Bile salts**
**Vitamin B12**




## Gallstones and renal stones

- Gall stones are related to bile salt and phospholipid depletion as a result of fat malabsorption and bile salt loss
- Renal stones are related to excess oxalate absorption as a result of intraluminal soap formation and depletion of calcium ions




# EVALUATION OF MALABSORPTION

- CONSEQUENCES

  weight, BMI

  ferritin, folate, B12 (methyl malonic acid, homocysteine)

  zinc, copper

  calcium, vitamin D, PTH

## EVALUATION OF MALABSORPTION

- CAUSE
  PROXIMAL Vs DISTAL
  ?steatorrhea (pancreas, biliary, intestinal)

Radiology (small intestine, CAT, USG)

Breath tests (bacterial overgrowth, lactose, fructose)

Biopsy

Video capsule endoscopy

## EVALUATION OF MALABSORPTION

- STOOL
  - O&P
  - GIARDIA ANTIGEN
  - FECAL FAT – quantitative, qualitative
  - PANCREATIC ELASTASE