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
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
  – lipase, colipase
**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, abetalipoproteinemia, chylomicron retention disease, giardiasis

• REMOVAL PHASE
  Lymphatic obstruction (lymphoma)
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
CARBOHYDRATE ABSORPTION

- Salivary amylase
- Pancreatic amylase
  - products of digestion maltose, maltotriose, and α-dextrins, some glucose
  - glucose actively absorbed
  - brush border enzymes digest oligosaccharides (lactase, sucrase)
  - fructose malabsorption
Breath H₂ excretion increases after lactose load in lactase deficiency

EXCRETION OF HYDROGEN AFTER LACTOSE INGESTION

- LACTOSE MEAL
- CARBOHYDRATE-FREE MEAL
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

Crohn's Disease

- Ischemia
- Radiation
- Strangulated bowel
- Trauma
- Tumor
- Jejunoileal bypass
- Neonatal disorders

Short Bowel Syndrome

Jejunal Resection

- Adequate absorption unless >75% resected
- Preserved absorption of B₁₂ and bile salts
- Good ileal adaptation
- Normal transit
**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