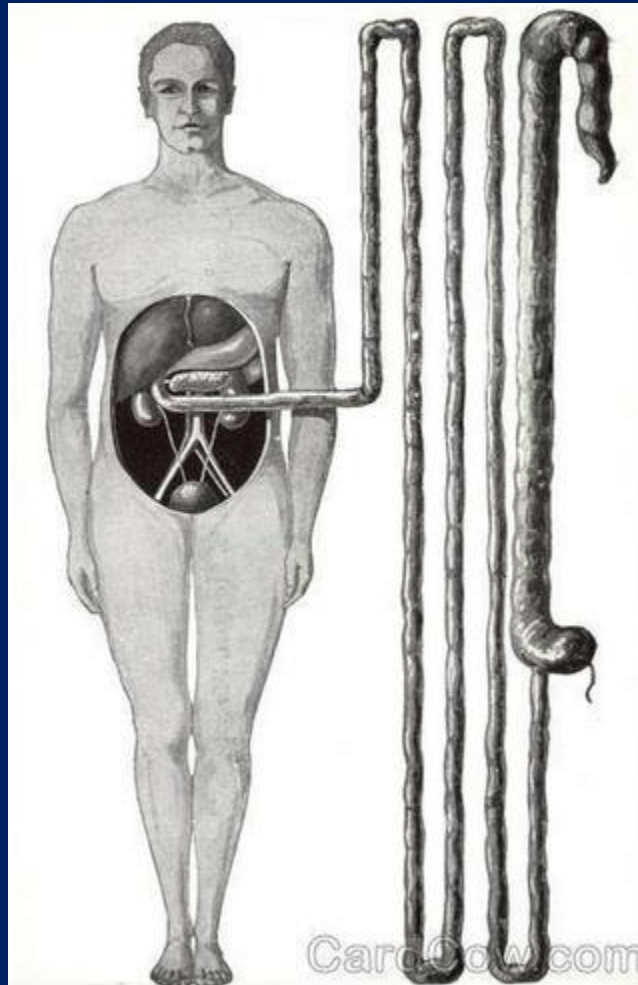


Malabsorption & Celiac Disease

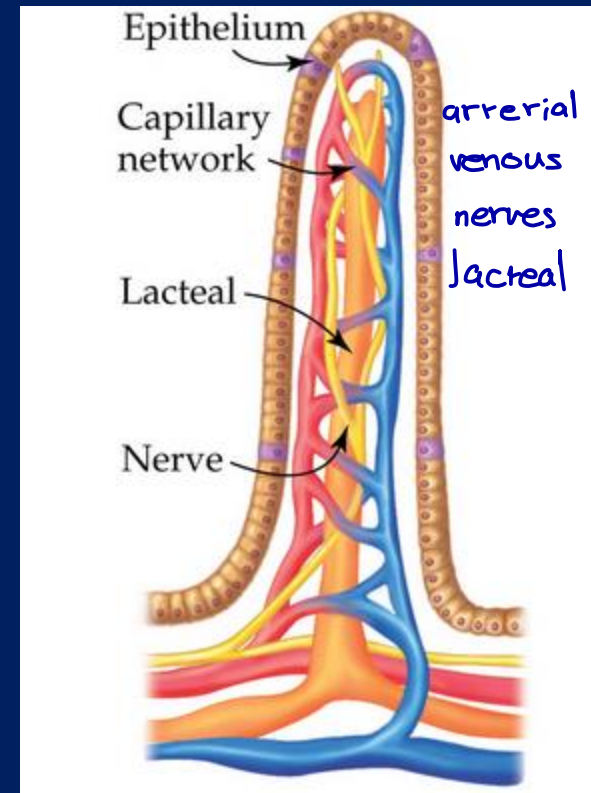
Edited by: Ruaa Adeib

Absorptive Capability

Measured Small Intestine Length = 6 Meters

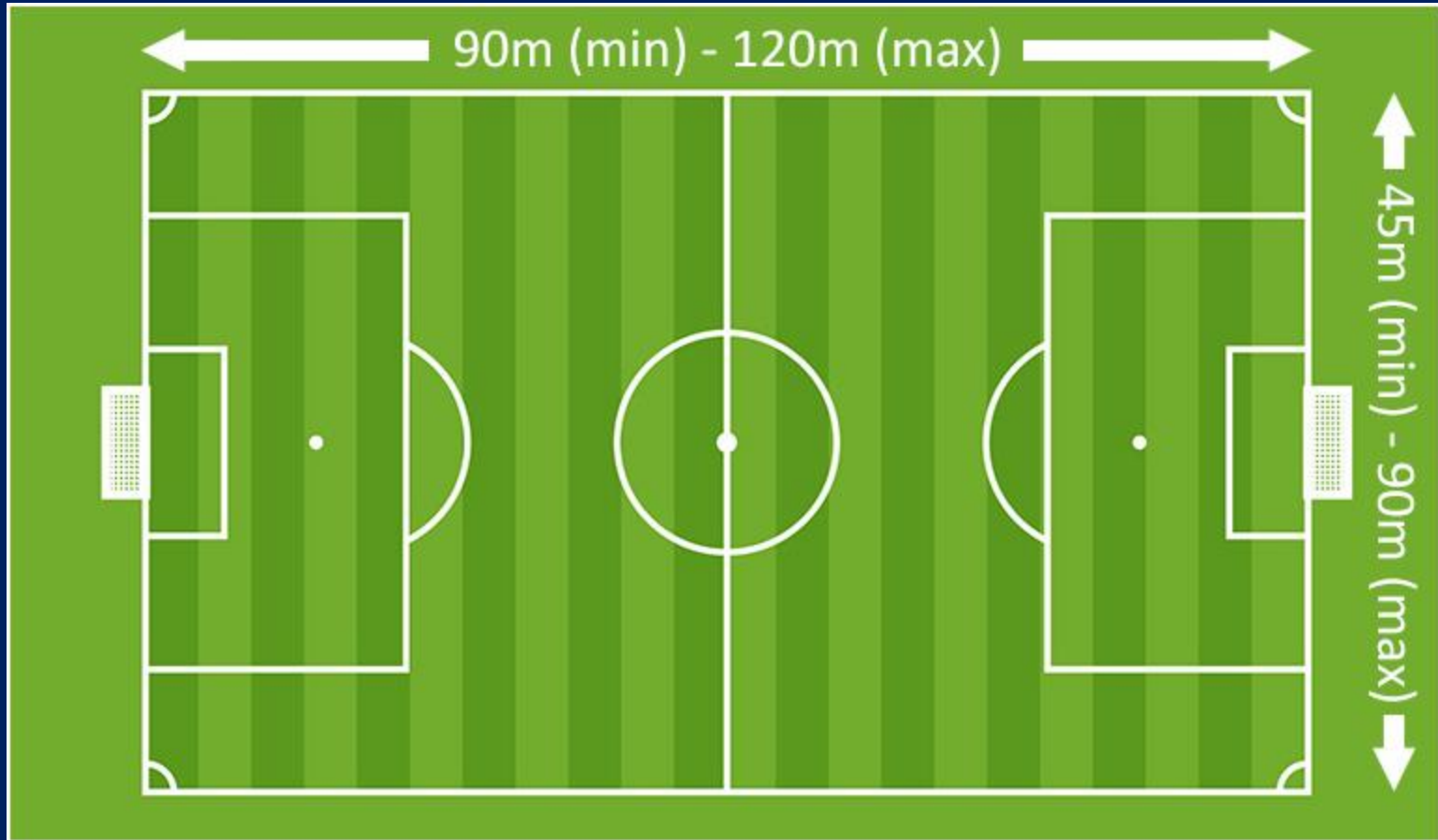


Absorptive Capability



Villi / Mico-Villi

Absorptive Capability



Standard Football Field

Maldigestion Vs Malabsorption

Maldigestion:

Impaired breakdown of nutrients (absorbable split-procarbohydrates, protein, fat) to ducts (mono-, di-, or oligosaccharides; amino acids; oligopeptides; fatty acids; monoglycerides)

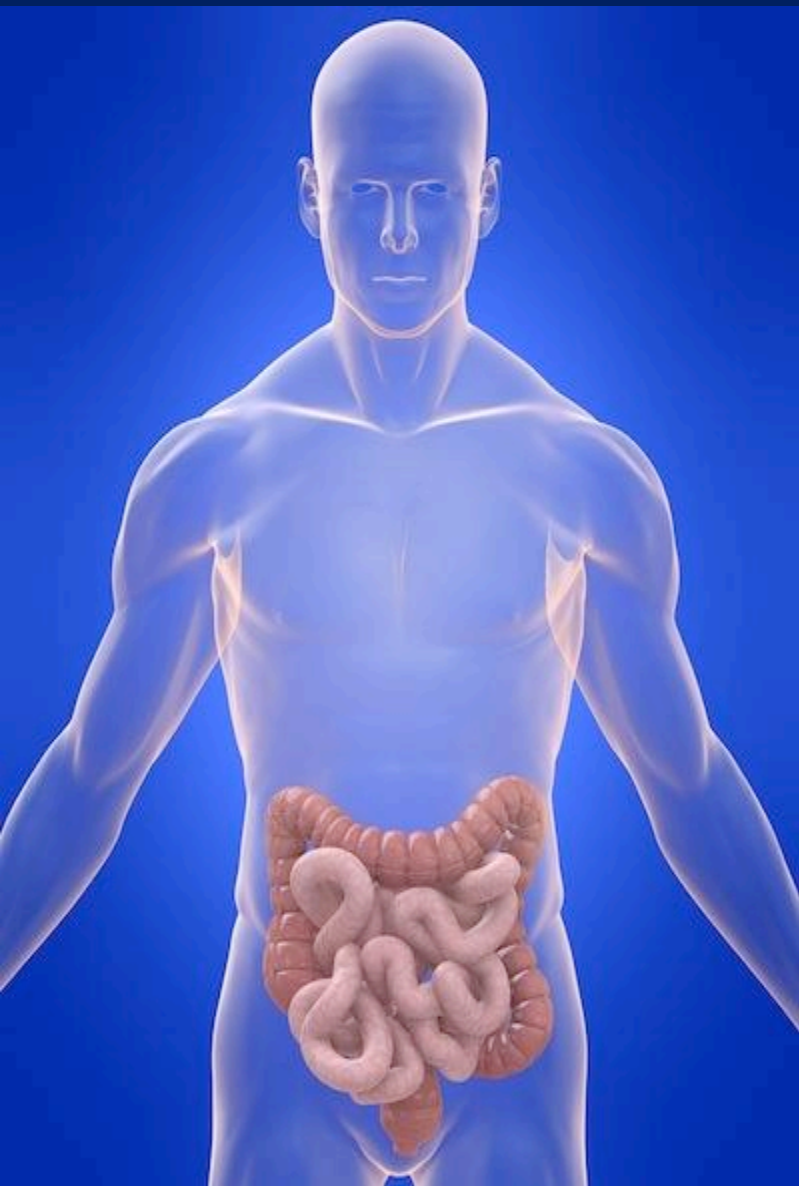
↳ malabsorption syndrome

Malabsorption:

Defective mucosal uptake and transport of adequately digested nutrients including vitamins and trace elements.

Malabsorption Syndrome

A clinical term that encompasses defects occurring during the digestion and absorption of food nutrients by the gastrointestinal tract.



The digestion or absorption of a single nutrient component may be impaired, as in lactose intolerance due to lactase deficiency.

However, when a diffuse disorder, such as Celiac disease or Crohn's disease, affects the intestine, the absorption of almost all nutrients is impaired.

extra (from old slides)

Maldigestion Vs Malabsorption

Maldigestion

- Inadequate mixing of food with enzymes (e.g. post-gastrectomy[?])
- ~~P~~ancreatic exocrine insufficiency[?]
- ^{primary} ~~I~~rry diseases of the pancreas[?]
(e.g. cystic fibrosis, pancreatitis, cancer)
- ~~B~~ile salt deficiency:
 - ↳ Terminal ileal disease
(impaired recycling), ^{90% is normally recycled}
 - Bacterial overgrowth
(deconjugation of bile salts), → ^{bile salt deficiency}
 - Liver disease (cholestatic)
↳ ^{PSC, PBC}
- Specific enzyme deficiencies
(e.g. lactase)^{deficiency}

Malabsorption

- Inadequate absorptive surface
 - infections/infestations ^{villous atrophy}
(e.g. Whipple's disease, Giardia)
 - immunologic or allergic injury
(e.g. celiac disease)
 - infiltration (e.g. lymphoma, amyloidosis)
 - ▣ fibrosis (e.g. systemic sclerosis, radiation enteritis)
 - bowel resection
 - extensive Crohn's disease
- Drug-induced:
 - ^{alkylating} cholestyramine, ^{alcohol} ETOH, neomycine
- Endocrine: ^{used when excessive bile (may cause diarrhea)}
 - DM (complex pathogenesis)
^{affects small bowel motility}

Pathophysiology

Malabsorption results from disturbance in at least one of the 3 phases of nutrients digestion & absorption:

- 1. Luminal phase (Defective digestion)***
- 2. Mucosal phase (Defective absorption)***
- 3. Post Absorptive phase (Deranged lymphatics)***

Where to start from?!!

The best way to classify the numerous causes of malabsorption is to consider the 3 phases of digestion and absorption.

Maldigestion

Impaired Luminal phase



Defect in the hydrolysis of nutrients

Luminal Phase “*digestion*”

❑ Pancreatic insufficiency

“The most common cause”

●Ch Pancreatitis ●CF ●Post Sx (Gastric/Pancreatic)
no enough juice to digest the food

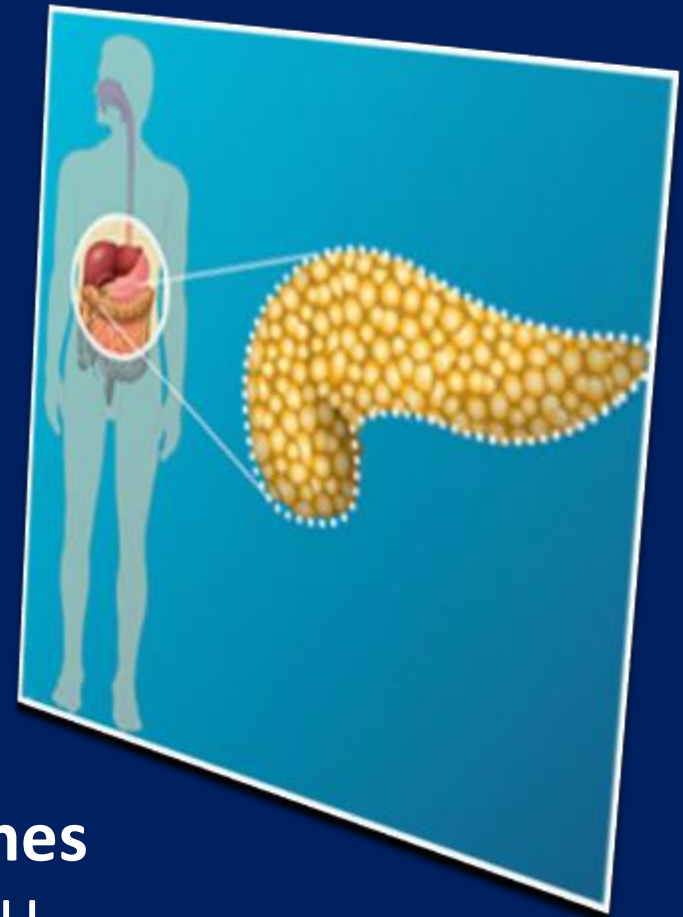
↓↓lipase & ↓↓proteases

lipid digestion is affected
lipid & protein malabsorption

❑ Inactivation of pancreatic enzymes

by gastric hypersecretion (ZE) *syndroms* → ↓pH

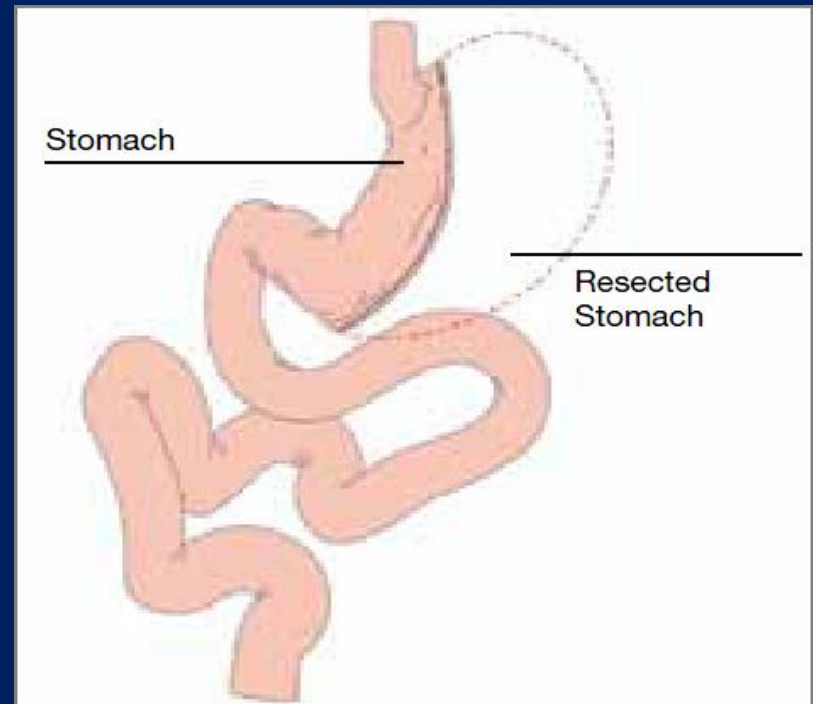
↑ gastrin ↑ acid ↓ pH



Luminal Phase

“digestion”

- ❑ **Post-Gastrectomy**
Inadequate mixing of
nutrients, bile, and
pancreatic enzymes,
also causes impaired
hydrolysis.



extra (from old slides)

Luminal Phase

“digestion”

❑ Impaired Micelle formation

Impaired micelle formation causes a problem in fat solubilization and subsequent fat malabsorption.

- **Decreased bile salt synthesis/secretion:**

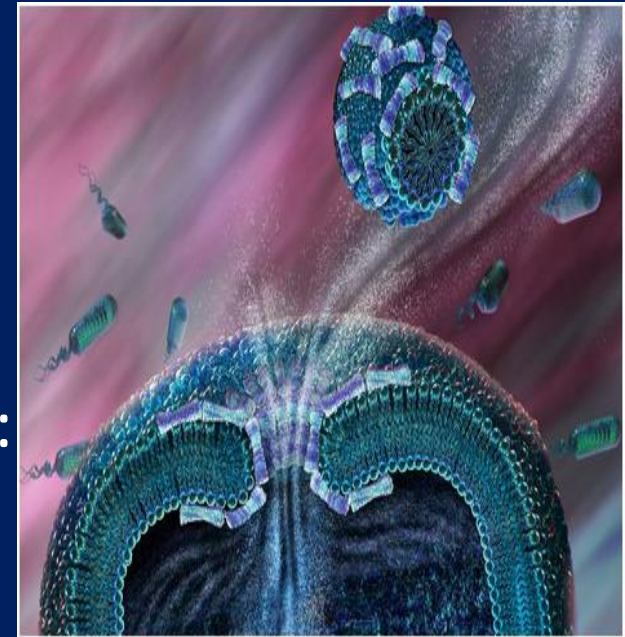
Liver diseases, Biliary obstruction,
Drugs (cholestyramine)

- **Impaired enterohepatic bile circulation**

Ileal resection/disease *crhons*

- **Bile salt deconjugation**

(SIBO)



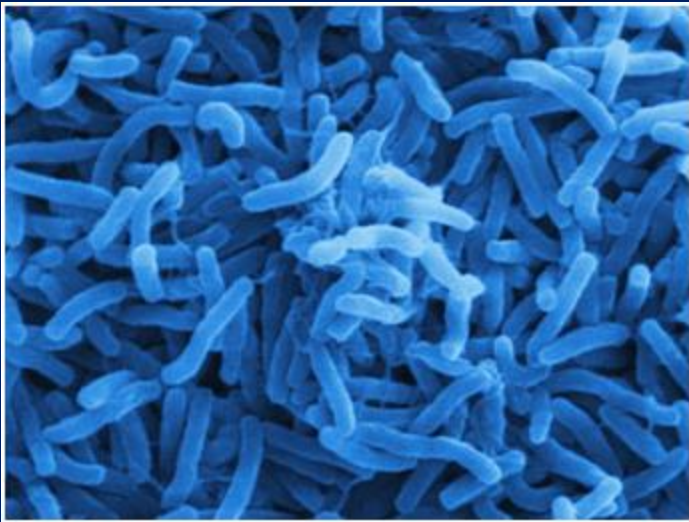
extra (from old slides)

Luminal Phase

"digestion"

Bile Salts Deconjugation:

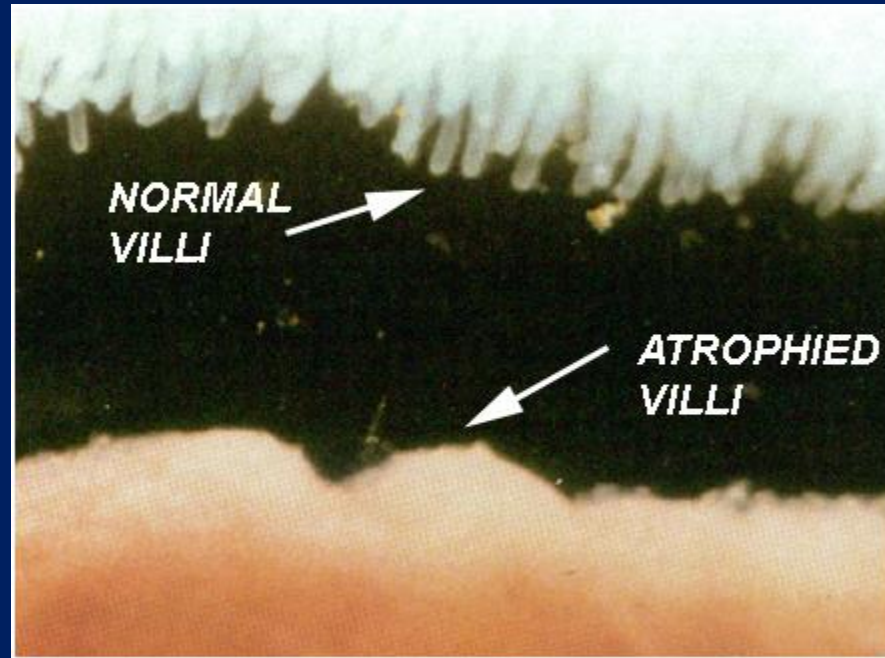
- Stasis of intestinal content caused by a motor abnormality (eg, scleroderma, diabetic neuropathy, intestinal obstruction),
- Anatomic abnormality (eg, small bowel stricture, *→ stasis* ischemia, blind loops),
- Small bowel contamination from enterocolonic fistulas can cause bacterial overgrowth
reflux of stool to small bowel



bacteria overgrowth

Mucosal phase

□ Mucosal damage: (Villous Atrophy)



columnarization

Mucosal phase

❑ Mucosal damage: (Villous Atrophy)

Celiac disease, Intestinal Lymphoma

Crohn's disease (CD), Eosinophilic enteritis, Auto-Immune Enteropathy (AIE), Common variable immunodeficiency, Amyloidosis

SIBO, Giardiasis, Whipple's disease, Tropical sprue, Viral GE, AIDS enteropathy, Intestinal TB

NSAIDs, Olmesartan

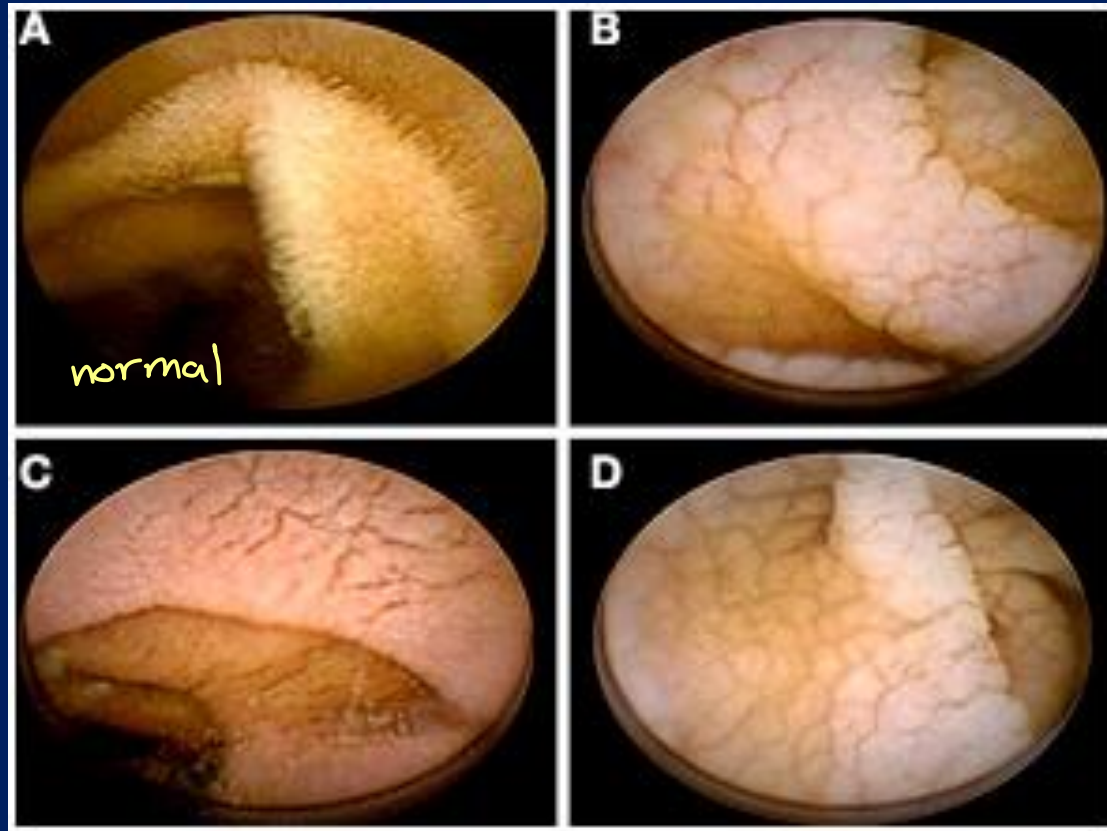
ZE synd (Gastrinoma)



↓surface area, ↓absorption/secretion

Mucosal phase

❑ Mucosal damage: (Villous Atrophy)



Fissuring
scalloping



extra (from old slides)

Mucosal phase

❑ ↓ Brush border Enzymes:

unabsorbed sugar causes diarrhea
(osmotic)

- Disaccharidase deficiency (**Lactase, Trehalase, Sucrose**) can lead to disaccharide malabsorption.

- ▶ Lactase deficiency, either Congenital or Acquired, is the most common form of disaccharidase deficiency.

- ▶ Acquired lactase deficiency can be due to acute gastroenteritis (rotavirus or giardia infection), chronic alcoholism, celiac sprue, radiation enteritis, regional enteritis, or AIDS enteropathy.

extra (from old slides)

Mucosal phase

- ❑ Immunoglobulin A (IgA) deficiency (most common immunodeficiency) is due to decreased or absent serum and intestinal IgA, which clinically appears similar to celiac disease and is unresponsive to a gluten-free diet.
- ❑ ⁶⁶Acrodermatitis enteropathica^{dd} is an autosomal recessive disease with selective inability to absorb zinc, leading to villous atrophy and acral dermatitis.
rash on skin & on the angles of the mouth

Post Absorptive Phase

"Lymphatics"

- Obstruction of the lymphatic system:

- Congenital

- (Intestinal Lymphangiectasia)

- Acquired

مثل كونه في جبهة محسورة فتا
المعده

Whipple disease, neoplasm (lymphoma), TB, CHF, Constrictive Pericarditis, Rad Tx, Retroperitoneal Fibrosis



impairs the absorption of chylomicrons & lipoproteins

↳ Malabsorptive syndrome

Pathophysiology of Clinical Manifestations of Malabsorption

Symptom or Sign	Mechanism
Weight loss/malnutrition	Anorexia, malabsorption of nutrients
Diarrhea	Impaired absorption or secretion of water and electrolytes; colonic fluid secretion secondary to unabsorbed dihydroxy bile acids and fatty acids
Flatus <i>Bloating</i>	Bacterial fermentation of unabsorbed carbohydrate
Glossitis, cheilosis, stomatitis	Deficiency of iron, vitamin B12, folate, and vitamin A
Abdominal pain	Bowel distention or inflammation, pancreatitis
Bone pain	Calcium, vitamin D malabsorption, protein deficiency, osteoporosis
Tetany, paresthesia	Calcium and magnesium malabsorption
Weakness	Anemia, electrolyte depletion (particularly K ⁺)
Azotemia, hypotension	Fluid and electrolyte depletion
Amenorrhea, decreased libido	Protein depletion, decreased calories, secondary hypopituitarism
Anemia	Impaired absorption of iron, folate, vitamin B12
Bleeding	Vitamin K malabsorption, hypoprothrombinemia
Night blindness/xerophthalmia	Vitamin A malabsorption
Peripheral neuropathy	Vitamin B12 and thiamine deficiency

Diarrhea

Hallmark of the disease

- ❑ Diarrhea is the most common symptomatic complaint
- ❑ Diarrhea is defined as an increase in stool mass, frequency, or fluidity, typically greater than 200 g per day.



Diarrhea can be classified according to 4 categories:

extra (from old slides)

- **Secretory diarrhea**

سواد صرسيه
او طميه ج
يفر عنده
is characterized by isotonic stool and persists during fasting.
there is hormone secretes fluids into the bowel lumen

- **Osmotic diarrhea**

اذا بصوم
بتخسر
due to the excessive osmotic forces exerted by unabsorbed luminal solutes. The diarrhea is over 100 mOsm more concentrated than plasma and abates with fasting.

- **Malabsorptive diarrhea**

follows generalized failures of nutrient absorption and is associated with **steatorrhea** and is relieved by fasting.

- **Exudative diarrhea**

pus
bloody
stool
2ry inflammatory disease & characterized by purulent, bloody stools that continue during fasting.

Steatorrhea

- Steatorrhea is the result of fat malabsorption.
- The hallmark of steatorrhea is the passage of pale, bulky, and malodorous stools.
- Such stools often float on top of the toilet water and are difficult to flush. Also, patients find floating oil droplets in the toilet following defecation. *very sticky & shinny*



Weight loss & fatigue

- Weight loss is common and may be pronounced; however, patients may compensate by increasing their caloric consumption, masking weight loss from malabsorption.
- The chance of weight loss increases in diffuse diseases involving the intestine, such as *celiac disease and *Whipple disease.



Masking effect!

Flatulence & abdominal distention



Bacterial fermentation of unabsorbed food substances

releases gaseous products, such as hydrogen and methane, causing flatulence.

Flatulence often causes uncomfortable abdominal distention and cramps.

Edema

سأشرح لكم
لماذا
والأسباب

- *Hypoalbuminemia from chronic protein malabsorption or from loss of protein into the intestinal lumen causes peripheral edema.
- Extensive obstruction of the lymphatic system, as seen in intestinal lymphangiectasia, can cause protein loss. develops edema bcs of:
 - hypervolemia
- With severe protein depletion, ascites may develop.

**THIS MAY BE
CAUSING
YOUR
EDEMA**

+
edema
=
anasarca



Anemia

- Depending on the cause, anemia resulting from malabsorption can be either microcytic (iron deficiency) or macrocytic (vitamin B-12 deficiency).
- Iron deficiency anemia often is a manifestation of celiac disease.
- Ileal involvement in Crohn disease or ileal resection can cause megaloblastic anemia due to vitamin B-12 deficiency.



Metabolic defects of bones



- Vitamin D deficiency can cause bone disorders, such as osteopenia or osteomalacia.

ADEK vitamins are affected

- Bone pain and pathologic fractures may be observed.
- Malabsorption of calcium can lead to secondary hyperparathyroidism.

**Carbohydrates
Malabsorption**

**P-P: ↑lumen Osm +
bacterial fermentation**

**Osmotic diarrhea
+ Flatus (Odorless) / Bloating
(≈No Wt changes)**

Carbohydrate Malabsorption

Etiology

Lactase deficiency:

(Most common *AE* of carbohydrate malabsorption)

- S/P intestinal resection
- Mucosal disease
- Post-infectious GE syndrome (Viral/Bacterial)
- Changing diet from Eastern → Western Diet

Carbohydrates Malabsorption

Workup

- **Stool Osmolality:**

Normally shall equal that of plasma Osmolality

Shall be measured; if not → will be considered ≈ 290

Stool gap: is normally a minimal difference 2ry to some $\ominus$ charged particles $\approx \underline{50 - 100}$ *should not exceed this*

So ...

Stool gap =

(Measured) (or ≈ 290) - (Calculated) [**stool ($\text{Na}^+ + \text{K}^+$) x2**]

Carbohydrates Malabsorption

Workup

- **Stool Osmotic gap**

>100 (Osmotic Diarrhea)

<100 not osmotic
secretory

- **Stool pH** *acidic*

<6 (Fermentation)

- **Lactase DNA Assay**

- **Breath testing w/H₂**

(↑fermentation of unabsorbed carbohydrate by bacteria) = Malabsorption

either I can't absorb the fat (small bowel problem)
or I can't hydrolyze the fat
(pancreatic enzymes problem)

Fat Malabsorption

Workup

Pancreatic
Vs
Small Bowel

(D-Xylose test)

25g D-xylose po →
serum level @1hr &/or urine
collection level x5hrs
↳ to see absorption
↳ to see excretion

N. Serum level: > 20mg/dL
N. Urine level: ≥ 4g

↓ level
(≤20mg/dL)
(Small Bowel Disease)
no enough absorptive
function

- SBBx biopsy
- SB Cx culture
- SB Imaging

(1) Imaging:

- X-Ray (Calcifications)
- CT
- MRCP
- EUS ↳ chronic pancreatitis

Rarely done (2) pancreatic function:

- Secretin (measure HCO_3^-)
↳ stimulate HCO_3^-
- CCK (measure lipase/trypsin)

(3) Alternatively:

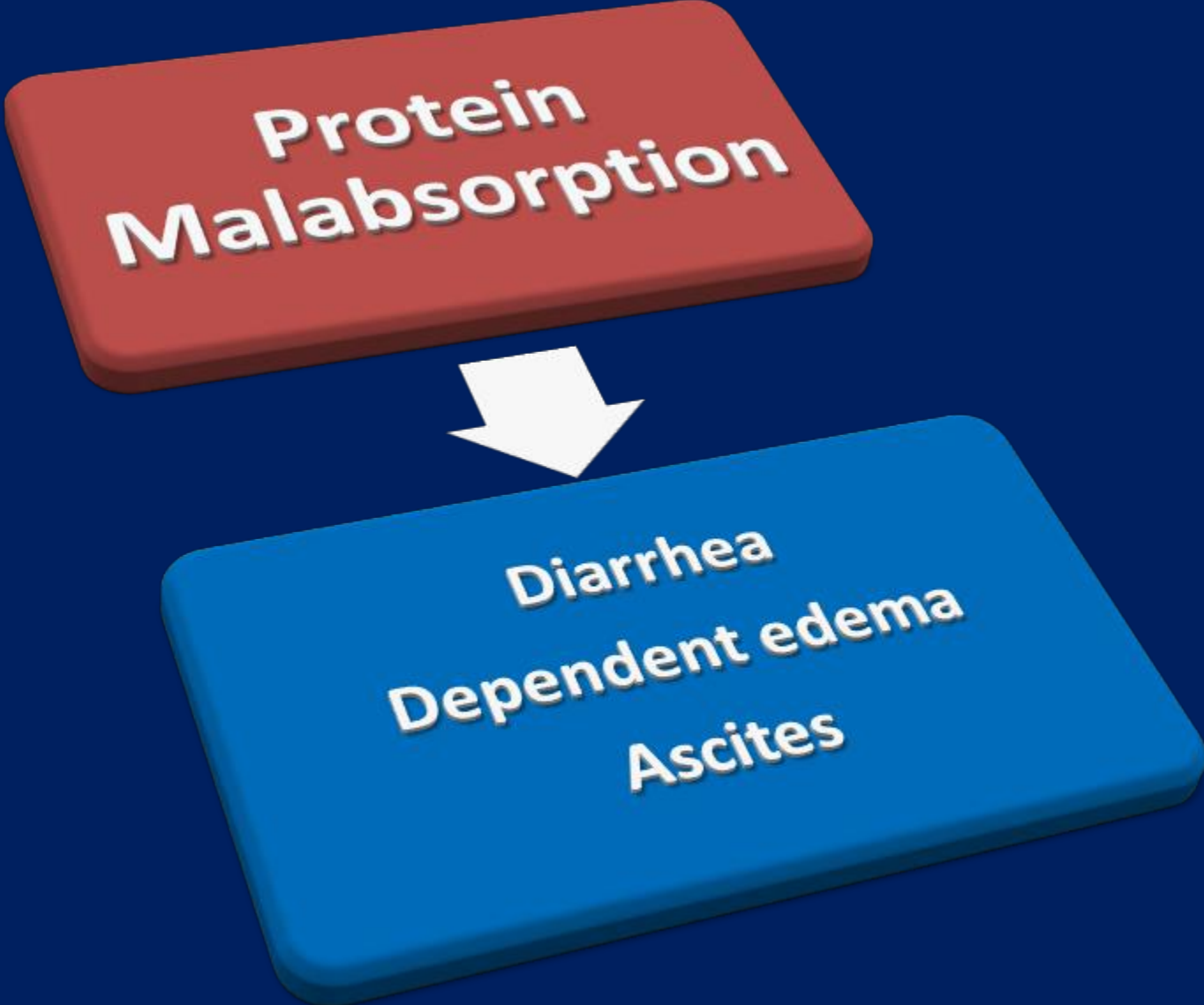
empiric trial of pancreatic
enzymes w/Quantify of fecal
fat before & after
if diarrhea improved then yes right!

**Fat
Malabsorption**



steatorrhea
Greasy foul smell Diarrhea
↓ Wt
fat-soluble Vit def (ADEK)

**Protein
Malabsorption**



```
graph TD; A[Protein Malabsorption] --> B[Diarrhea<br/>Dependent edema<br/>Ascites];
```

**Diarrhea
Dependent edema
Ascites**