Malabsorption

Definition

- **Malabsorption** is a state arising from abnormality in absorption of food nutrients across the gastrointestinal(GI) tract.

Pathophysiology

- The main purpose of the gastrointestinal tract is to digest and absorb nutrients (fat, carbohydrate, and protein), micronutrients (vitamins and trace minerals), water, and electrolytes.

- Digestion involves both mechanical and enzymatic breakdown of food.
- **Mechanical processes** include chewing, gastric churning, and the to-and-fro mixing in the small intestine.
- **Enzymatic hydrolysis** is initiated by intraluminal processes requiring gastric, pancreatic, and biliary secretions. The final products of digestion are absorbed through the intestinal epithelial cells.

Malabsorption constitutes the pathological interference with the normal physiological sequence of

- digestion (intraluminal process),
- absorption (mucosal process) and
- transport (postmucosal events) of nutrients

Intestinal malabsorption can be due to

- Mucosal damage (enteropathy)
- Congenital or acquired reduction in absorptive surface
- Defects of specific hydrolysis
- Defects of ion transport
- Pancreatic insufficiency
- Impaired enterohepatic circulation

Causes

Due to infective agents

- Whipple's disease
- Intestinal tuberculosis
- HIV related malabsorption
- Tropical sprue
- traveller's diarrhoea
- Parasites .e. g. *Giardia lamblia*, fish tape worm (B12 malabsorption); roundworm , hookworm (*Ancylostoma duodenale* and *Necator americanus*)

- **Due to mucosal abnormality**
  Coeliac/Celiac disease
- Cows' milk intolerance
- Soya milk intolerance
- Fructose malabsorption

Due to digestive failure

- Pancreatic insufficiencies:
- cystic fibrosis
- chronic pancreatitis
- carcinoma of pancreas
- Zollinger-Ellison syndrome

Bile salt malabsorption

- terminal ileal disease
- obstructive jaundice
- bacterial overgrowth

Due to structural defects

- Blind loops
- Inflammatory bowel diseases commonly in Crohn's Disease
- Intestinal hurry from Post-gastrectomy; post-vagotomy,
- Fistulae, diverticulae and strictures,
- Infiltrative conditions such as amyloidosis, lymphoma,
- Radiation enteritis
- Systemic sclerosis and collagen vascular diseases
- Short gut syndrome

Due to enzyme deficiencies

- Lactase deficiency inducing lactose intolerance (constitutional, secondary or rarely congenital)
- Sucrose intolerance
- Intestinal disaccharidase deficiency
- Intestinal enteropeptidase deficiency

Due to other systemic diseases affecting GI tract

- Hypothyroidism and hyperthyroidism
- Addison's disease
- Diabetes mellitus
- Hyperparathyroidism and Hypoparathyroidism
- Carcinoid syndrome
- Malnutrition
- Abeta-lipoproteinemia

Clinical Features

- It can present in variety of ways and features might give clue to underlying condition.
- Symptoms can be

  intestinal or

  extra-intestinal
- The former predominates in severe malabsorption.

- **Diarrhoea, often steatorrhoea** is the most common feature.
- Watery, diurnal and nocturnal, bulky, frequent stools are the clinical hallmark of overt malabsorption.
- It is due to impaired water, carbohydrate and electrolyte absorption or irritation from unabsorbed fatty acid.
- Latter also results in **bloating, flatulence and abdominal discomfort**. Cramping pain usually suggests obstructive intestinal segment e.g. in Crohn's disease, especially if it persists after defecation.

- **Weight loss** can be significant despite increased oral intake of nutrients .
- Growth retardation, failure to thrive, delayed puberty in children
- Swelling or oedema from loss of protein
- Anaemias, commonly from vitamin B12, folic acid and iron deficiency presenting as fatigue and weakness.
- Muscle cramp from decreased vitamin D, calcium absorption. Also lead to osteomalacia and osteoporosis
- Bleeding tendencies from vitamin K and other coagulation factor deficiencies

Diagnosis

- There is no specific test for Malabsorption.
- As for most medical conditions, investigation is guided by symptoms and signs.
- Moreover, tests for pancreatic function are complex and varies widely between centres

Blood tests

Routine blood tests

- Anaemia, high ESR or low albumin

  In this setting, microcytic anaemia usually implies iron deficiency and macrocytosis can be from impaired folic acid or B12 absorption or both.
- Low cholesterol or triglyceride may give clue toward fat malabsorption as low calcium and phosphate toward osteomalacia from low vitamin D.

- Specific vitamins like vitamin D or micro nutrient like zinc levels can be checked. Fat soluble vitamins (A, D, E & K) are affected in fat malabsorption. Prolonged prothrombin time can be from vitamin K deficiency.

Serological studies

- Specific tests are carried out to determine underlying cause.
- IgA tissue trans glutamate or IgA antiendomysium assay for gluten sensitive enteropathy.

Stool Tests

- Microscopy is particularly useful in diarrhoea, may show protozoa like giardia, ova, cyst and other infective agents.
- Fecal fat study to diagnose steatorrhoea is less frequently performed nowadays.
- Low elastase is indicative of pancreatic insufficiency. Chymotrypsin and pancreolauryl can be assessed as well

Radiological studies

- Barium follow through is useful in delineating small intestinal anatomy. Barium enema may be undertaken to see colonic or ileal lesions.
- CT abdomen is useful in ruling out structural abnormality, done in pancreatic protocol when visualising pancreas.
- Magnetic resonance cholangiopancreatography (MRCP) to complement or as an alternative to ERCP

Interventional studies

- Endoscopy is frequently undertaken, but to visualise small intestine, which can be up to 7m long, is indeed a daunting task
- OGD to reveal duodenal lesion also for D2 biopsy (for celiac disease, tropical sprue, Whipple's disease, A-b-lipoproteinemia etc.)
- Enteroscopy for enteropathy and jejunal aspirate and culture for bacterial overgrowth
- Colonoscopy is helpful in colonic or ileal lesion.
- ERCP

Other Tests

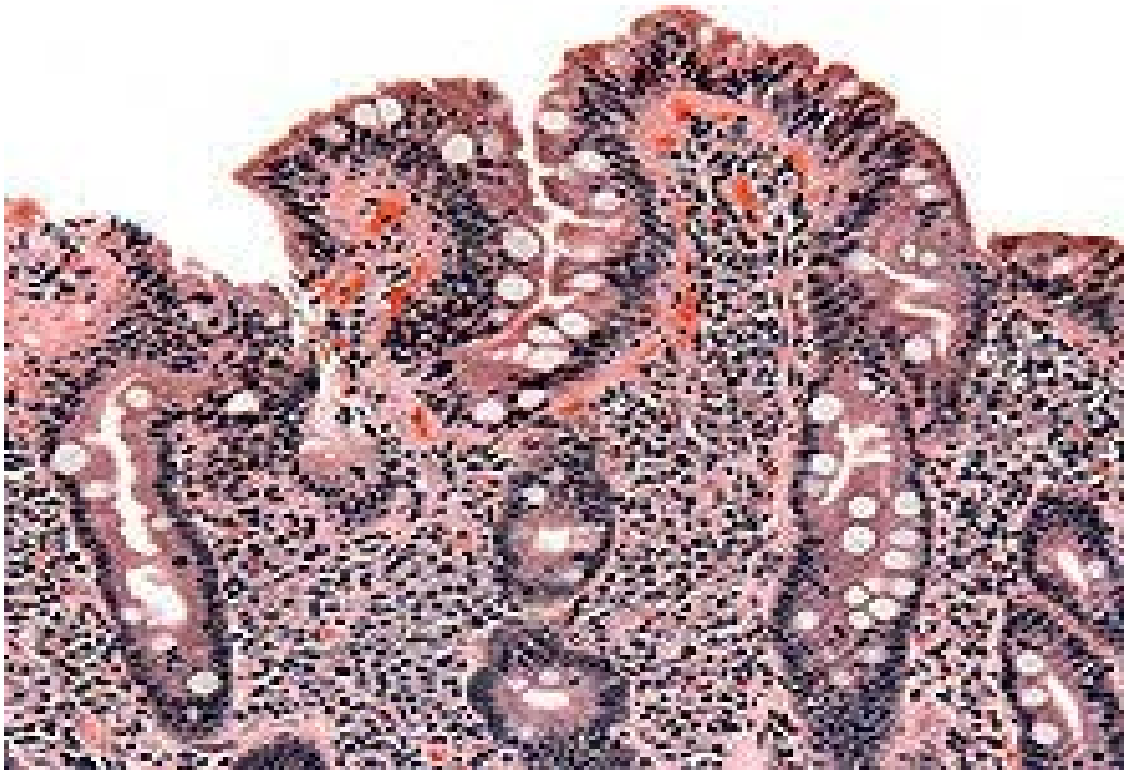
- Radio isotope tests e.g. 75SeHCAT, 95mTc to exclude terminal ileal disease.
- Sugar probes or sub 51Cr-EDTA to determine intestinal permeability.
- Glucose hydrogen breath test for bacterial overgrowth
- D-xylose absorption test. lower level in urine after ingestion indicates bacterial overgrowth or reduced absorptive surface. normal in pancreatic insufficiency.
- Bile salt breath test to determine bile salt malabsorption.
- Schilling test to establish cause of B12 deficiency.
- Lactose H2 breath test for lactose intolerance

Treatment

- Management of underlying cause.
- Replacement of nutrients, electrolytes and fluid may be necessary. In severe deficiency, hospital admission may be required for parenteral administration, often advice from dietitian is sought.
- People whose absorptive surface are severely limited from disease or surgery may need long term total parenteral nutrition. Pancreatic enzymes are supplemented orally in insufficiencies.

- Dietary modification is important in some conditions. Life-long avoidance of particular food or food constituent may be needed in Celiac disease or lactose intolerance.
- Bacterial overgrowth usually respond well to course of antibiotic. Use of cholestyramine to bind bile acid will help reducing diarrhea in bile acid malabsorption

Biopsy of small bowel showing **coeliac disease** manifested by blunting of villi, crypt hyperplasia, and lymphocyte infiltration of crypts



Mechanisms of Malabsorption, Malabsorbed Substrates, and Representative Causes

Maldigestion

- Conjugated bile acid deficiency Fat
  - Fat-soluble vitamins
  - Calcium
  - Magnesium
  - Hepatic parenchymal disease
  - Biliary obstruction
  - Bacterial overgrowth with bile acid deconjugation
  - Ileal bile acid malabsorption
  - CCK deficiency

- Pancreatic insufficiency Fat
  Protein
  Carbohydrate
  Fat-soluble vitamins
  Vitamin B12 (cobalamin)
  Congenital defects
  Chronic pancreatitis
  Pancreatic tumors
  Inactivation of pancreatic enzymes (e.g., Zollinger-Ellison syndrome)
  Reduced mucosal digestion Carbohydrate
  Protein
  Congenital defects (see Table 101-14)
  Acquired lactase deficiency
  Generalized mucosal disease (e.g., celiac disease, Crohn's disease)
  Intraluminal consumption of nutrientsVitamin B12 (cobalamin) Small intestinal bacterial overgrowth
  Helminthic infections (e.g., *Diphyllobothrium latum* infection)

- **Malabsorption**

- Reduced mucosal absorption
  - Fat
  - Protein
  - Carbohydrate
  - Vitamins
  - Minerals
  - Congenital transport defects
  - Generalized mucosal diseases (e.g., celiac disease, Crohn's disease)
  - Previous intestinal resection or bypass
  - Infections
  - Intestinal lymphoma
- Decreased transport from the intestine
  - Fat
  - Protein
  - Intestinal lymphangiectasia
    - Primary
    - Secondary (e.g., solid tumors, Whipple's disease, lymphomas)
  - Venous stasis (e.g., from congestive heart failure)

- **Other Mechanisms**

  Decreased gastric acid and/or intrinsic factor secretion

  Vitamin B12 Pernicious anemia
  Atrophic gastritis
  Previous gastric resection

  Decreased gastric mixing and/or rapid gastric emptying

  Fat
  Calcium
  Protein
  Previous gastric resection
  Autonomic neuropathy

  Rapid intestinal transit

  Fat

  Autonomic neuropathy
  Hyperthyroidism

Symptoms and Signs of Malabsorption and Relevant Pathophysiology

SYMPTOM OR SIGN	PATHOPHYSIOLOGIC EXPLANATION
Gastrointestinal	
Diarrhea	
	Osmotic activity of carbohydrates or short-chain fatty acids
	Secretory effect of bile acids and fatty acids
	Decreased absorptive surface
	Intestinal loss of conjugated bile acids
	Ileal resection
	Severe ileal mucosal disease
	Congenital defects of the ileal sodium–bile acid cotransporter
	Protein loss or malabsorption

○ Abdominal distention, flatulence	Bacterial gas production from carbohydrates in colon, small intestinal bacterial overgrowth	
○ Foul-smelling flatulence or stool	Malabsorption of proteins or intestinal protein loss	
○ Pain	Gaseous distention of intestine	
○ Ascites		
○ **Musculoskeletal**		
○ Tetany, muscle weakness, paresthesia	Malabsorption of vitamin D, calcium, magnesium, and phosphate	
○ Bone pain, osteomalacia, fractures	Protein, calcium, or vitamin D deficiency; secondary hyperparathyroidism	

- **Cutoneous and Mucosal**
- Easy bruisability, ecchymoses, petechiae Vitamin K deficiency and vitamin C deficiency (scurvy)
- Glossitis, cheilosis, stomatitis Vitamin B complex, vitamin B_{12}, folate, or iron deficiency
- Edema Protein loss or malabsorption
- Acrodermatitis, scaly dermatitis Zinc and essential fatty acid deficiency
- Follicular hyperkeratosis Vitamin A deficiency
- Hyperpigmented dermatitis Niacin deficiency (pellagra)
- Thin nails with spoon-shaped deformity Iron deficiency
- Perifollicular hemorrhage Malabsorption of vitamin C
- Spiral or curly hair Malabsorption of vitamin C

- **Other**
- Weight loss, hyperphagia — Nutrient malabsorption
- Growth and weight retardation, infantilism — Nutrient malabsorption in childhood and adolescence
- Anemia — Iron, folate, or vitamin B_{12} deficiency
- Kidney stones — Increased colonic oxalate absorption
- Amenorrhea, impotence, infertility — Multifactorial (including protein malabsorption, secondary hypopituitarism, anemia)
- Night blindness, xerophthalmia — Vitamin A deficiency
- Peripheral neuropathy — Vitamin B_{12} or thiamine deficiency
- Fatigue, weakness — Calorie depletion, iron and folate deficiency, anemia
- Neurologic symptoms, ataxia — Vitamin B_{12}, vitamin E, or folate deficiency