Malabsorption

Malabsorption ; A defect in the absorption of one or more nutrients.

• Malabsorption syndromes encompass numerous clinical entities that result in chronic diarrhea, abdominal distention, and failure to thrive.

Pathophysiology :

Carbohydrate, fat, or protein malabsorption is caused by a disorder in the intestinal processes of digestion, transport, or both of these nutrients across the intestinal mucosa into the systemic circulation.

• Either a congenital abnormality in the digestive or absorptive processes or, more commonly, a secondarily acquired disorder of such processes may result in malabsorption.

1-Disorders of Carbohydrate metabolism

Disorders of Carbohydrate metabolism can be: ❖

1-congenital : cystic fibrosis and Shwachman-Diamond syndrome, which may cause ❖ amylase deficiency; the extremely rare congenital lactase deficiency; sucrase-isomaltase deficiency;

2-acquired: the most common being lactose intolerance, typically secondary to a damage of the mucosa, such as a viral enteritis .

conditions that cause mucosal atrophy, such as celiac disease.

2-Disorders of protein metabolism:

1-**Congenital**: cystic fibrosis, Shwachman-Diamond syndrome, and enterokinase deficiency, which cause inadequate intraluminal digestion.

2-**Acquired**: disorders of protein digestion and/or absorption are nonspecific (ie, they also affect the absorption of carbohydrates and lipids) and are found in conditions that result in damage to the absorptive intestinal surface, such as extensive viral enteritis, milk protein allergy enteropathy, and celiac disease

3-Disorders of Lipid metabolism:

1-Congenital: cystic fibrosis and ShwachmanDiamond syndrome, which cause lipase and colipase deficiency. congenital primary bile acid malabsorption.

2-Acquired (secondary mostly to disorders of the liver and the biliary tract or to chronic pancreatitis). Clearly, any condition that results in the loss of small intestinal absorptive surface also causes steatorrhea.

Epidemiology

1-Genetically determined syndromes a:

Celiac disease is by far the most common inherited malabsorption syndrome.

Cystic fibrosis is the second most common malabsorption syndrome.

2- Acquired syndromes :

Cow's milk and soy milk protein allergies are common, especially in infants and young children.

A transient and common form of malabsorption in infants results from acute-onset enteritis (mostly viral, specifically rotaviral), which causes transient lactose intolerance.

3-Gender:

Celiac disease is slightly more common in females.

Autoimmune enteropathy is an X-linked disorder that only affects males in familial cases.

4-Age:

Symptoms of a congenital disease are usually apparent shortly after birth or after a short hiatus once
a particular substance is ingested in substantial amounts.

Protein sensitivity syndromes to milk or soy protein usually present in infants younger than 3 months.

Solid food protein sensitivity syndromes are known to occur in older patients .

Clinical Presentation:

1-Diet history: Obtain a complete history of the patient's diet, including the amount and type of fluids, solid foods, and formula ingested.

2- GI tract symptoms: abdominal gaseous distention , abdominal pain , nausea &vomiting, Dehydration , Chronic or recurrent diarrhea , Poor appetite, failure to thrive, poor weight gain ,skin irritation in the perianal area due to acidic stools are characteristic of carbohydrate malabsorption syndrome .

3- Other symptoms :

Systemic symptoms, including weakness, fatigue, and failure to thrive.

Protein sensitivity may be associated with an eczematous rash.

folate and B-12 malabsorption result in macrocytic anemia.

Patients with abetalipoproteinemia develop retinitis pigmentosa and ataxia because of chronic fat-soluble vitamin malabsorption and deficiency (vitamins A and E).

Classification and etiology of malabsorption :

a) Disorders of intraluminal digestion.
b) Disorders of transport in the intestinal mucosal cell.
c) Disorders of transport from mucosal cell.
d) Systemic diseases associated with malabsorption.
e) Drugs causing malabsorption.

1-**Disorders of intraluminal digestion:**

a) Pancreatic insufficiencies: -cystic fibrosis -chronic pancreatitis -carcinoma of pancreas .
b) Bile salt insufficiency: -obstructive jaundice, bacterial overgrowth
c) Rapid transit of food through gut -Gastroenterostomy -partial gastrectomy .
d) Increased bile salt loss in faeces -terminal ileal disease Crohn’s disease -terminal ileal resection .

e) Lack of intrinsic factor -pernicious anemia

2-**Disorders of transport in the intestinal mucosal cell**:

-lactase deficiency

• Defect in epithelial transport

-coeliac disease

-tropical sprue

-lymphoma

3-**Disorders of transport from mucosal cell**:

Lymphatic obstruction

-abdominal lymphoma

-tuberculosis

-lymphangiectasia

• Defect in epithelialprocessing

-abetalipoproteinaemia

4-**Systemic diseases associated with malabsorption**:

Addison's disease

• Thyrotoxicosis

• Hypothyroidism

• Diabetes mellitus

• Collagen vascular disease.

5-**Drugs causing malabsorption**:

Colchicine &Neomycin-precipitation of bile salts in gut, inhibition of lactase

• Methotrexate-folic acid antagonist.

• Cholestyramine-bindingbile salts

• Laxatives.

Laboratory Studies:

The following laboratory studies are indicated in malabsorption syndromes:

- Stool analysis
- CBC
- liver function tests
- Total serum protein and albumin
- Celiac screening
- Imaging Studies, Barium studies
- Substance tolerance test
- Endoscopy
- Biopsy of Small-Intestinal Mucosa.

1-Stool analysis:

Reducing substances indicates that carbohydrates have not been properly absorbed.

Acidic stool has a pH level of less than 5.5. This indicates carbohydrate malabsorption, even in the absence of reducing substances.

Normally, stool bile acids should not be detected.

The level of quantitative stool fat and the amount of fat intake should be measured and monitored for 3 days.

Examination of the stool for ova and parasites may reveal the presence of Giardia species, a known cause of acquired malabsorption syndromes.

Testing for other chronic intestinal infections that cause malabsorption, such as Clostridium difficile or Cryptosporidium species may be performed.

2- A CBC : • megaloblastic anemia in patients with folate and vitamin B-12 malabsorption ,

Neutropenia in patients with Shwachman-Diamond syndrome (associated with pancreatic insufficiency).

In patients with abetalipoproteinemia, blood smears may reveal acanthocytosis.

In patients with inflammatory bowel disease, the erythrocyte sedimentation rate, C-reactive protein level, or both are commonly elevated.

3-Total serum protein and albumin levels :may be lower than reference range in syndromes in which protein is lost or is not absorbed, particularly in: o protein-losing enteropathy and o pancreatic insufficiency or o enterokinase deficiency.

4- liver function test :With bile acid malabsorption, levels of the low-density lipoprotein (LDL) cholesterol may be low. In patients with liver or biliary disease, the results of liver function tests may be higher.

5-Immunoglobulin G (IgG) and immunoglobulin A (IgA) antigliadin and IgA antiendomysial antibodies, or especially tissue transglutaminase antibodies, are useful in the diagnosis of glutensensitive enteropathy.

6-Recently, a 13C-Sucrose breath test has been proposed as a noninvasive, easy-touse, integrated marker of the absorptive capacity and integrity of the small intestine.

7- Carbohydrate malabsorption tolerance test :

Carbohydrate malabsorption results in bacterial fermentation. This biochemical process releases hydrogen gas that is absorbed into the blood and excreted by the lungs. • The amount of carbohydrate administered is typically 2 g/kg, with a maximum dose of 50 g. • An increase in the exhaled hydrogen concentration following ingestion of an oral carbohydrate load (>20 ppm) indicates carbohydrate malabsorption.

8- Endoscopy:

Gross morphology –

gives diagnostic clue –Cobblestone appearance – Crohn's disease. –Reduced duodenal folds and scalloping of duodenal mucosa – celiac disease

Biopsy of Small-Intestinal Mucosa:

primary indications:

(1) evaluation of a patient either with documented or suspected steatorrhea or with chronic diarrhea.

(2) diffuse or focal abnormalities of the small intestine defined on a small-intestinal series.

Lesions seen : classified into three 1. Diffuse,specific: (Agammaglobulinemia, –Abetalipoproteinemia)

2. Patchy, specific (Crohn's disease, –Intestinal lymphoma).

3. Diffuse,non-specific (celiac sprue, – Tropical sprue – Bacterial overgrowth).

9- Barium studies:

evaluation of the patient with presumed or suspected malabsorption • small-bowel series -a useful examination to look for anatomical abnormalities, such as strictures and fistulas (as in Crohn's disease) or blind loop syndrome (e.g., multiple jejunal diverticula), and to define the extent of a previous surgical resection.

Treatment:

Replacement of nutrients, electrolytes and fluid may be necessary.

In severe deficiency, hospital admission may be required for parenteral administration.

Pancreatic enzymes are supplemented orally in pancreatic insufficiency.

Dietary modification is important in some conditions: – Gluten-free diet in coeliac disease. – Lactose avoidance in lactose intolerance. – Food allergic enteropathy need to be on an elimination diet, avoiding offending food antigens.

Antibiotic therapy will treat Small Bowel Bacterial overgrowth (eg, metronidazole , rifaximin).

cholestyramine :In children with chronic diarrhea secondary to bile acid malabsorption, the use of cholestyramine.

Immunosuppressive medications can be used to control autoimmune enteropathy .

Diet:

Carbohydrate intolerance :

Initiate treatment in patients with severe acquired carbohydrate intolerance by eliminating all dietary carbohydrates until the diarrhea is resolved. Then, slowly reintroduce carbohydrates.

In infants, use a glucose polymer (Polycose)– based formula (eg, Pregestimil).

In patients with the most severe carbohydrate intolerance, a casein-based formula that contains essential amino acids and medium-chain triglyceride (MCT) oil and no carbohydrates.

Fat intolerance :

MCT oil is used to treat patients with poor weight gain that results from fat malabsorption.

MCT oil does not require traditional fat metabolism and, thus, is more easily absorbed directly into the enterocyte and is transported through the portal vein to the liver.

Fat-soluble vitamin supplements are required.

Supplements in patients with fat malabsorption should also include linoleic and linolenic fatty acids.

Alternative formulas (protein intolerance) :

Currently, soy formulas are not considered effective for the prevention or treatment of nutritional allergies. Instead, use hydrolyzed protein formulas.

High-degree protein hydrolysate formulas are used to treat infants with a cow's milk allergy, but these formulas may contain residual epitopes capable of provoking a severe allergic reaction.

In these infants, use formulas with crystalline amino acids (eg, Neocate, EleCare) as the protein source.

Prognosis:

Mucosal atrophy caused by infectious gastroenteritis, food-sensitivity enteropathies, or malnutrition can result in an 80% reduction of intestinal surface area.

Once the causative agent is removed, the repair of the small bowel is usually rapid (4-6 days).

Some malabsorption syndromes are transient, whereas others simply require a change in diet.

Bacterial overgrowth compromises intestinal adaptation and increases the risk of liver disorders.

<u>Calculating Drop rate per minutes</u>:

(Solution) ml x 15 /hr x min

Example : 540 ml x15/8 hr x 60 =16 drops per minute.

540mlx15/16x60=8 drops per minute.

Caelic disease:

Celiac disease is defined as a multisystem disorder that causes the body's immune system to respond to the protein in certain grains.

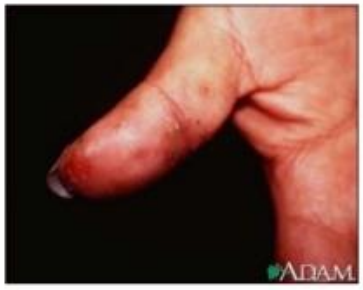
Clinical Presentation:

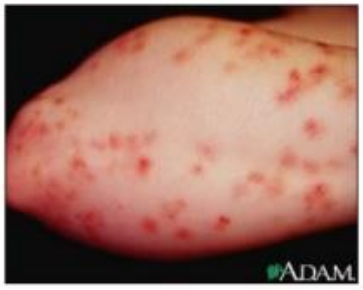
- The most commonly recognized symptoms of celiac disease relate to the improper absorption of food in the GIT.
- Patient presents with ***diarrhea (<50%)***, ***steatorrhea***, ***flatulence***, ***distended abdomen***, ***weight loss***, & ***generalized weakness.***
- Up to ***38 %*** of patients are ***asymptomatic.***
- Unrecognized celiac disease may cause ***malabsorption***, ***iron deficiency anemia***, ***osteoporosis***, ***osteomalacia*** causing bone fractures, pain & bony deformities.
- People with celiac disease may also experience ***lactose intolerance*** due to ***lactase enzyme deficiency.***

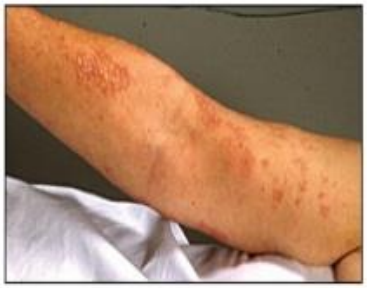
Dermatitis Hypertiformis

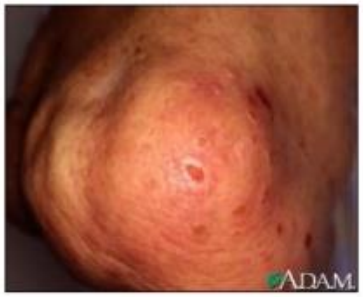
- ***Dermatitis herpetiformis (DH)*** is the skin manifestation of celiac disease.
- It is an ***intensely itchy rash*** that occurs in the hands, fingers, forearms, buttocks or scalp or anywhere on the body.
- The rash typically consists of intensely itchy, small red dots that may develop into blisters or pimples.
- Approximately ***10%*** of patients with celiac disease have DH, & it is estimated that ***> 85%*** of patients with DH have celiac disease .

Dermatitis Hypertiformis









Celiac Disease & the Lung:

- The association between ***celiac disease*** & ***diffuse interstitial pulmonary disease*** has been suspected since ***1970.***
- ***Extrinsic allergic alveolitis*** was found in combination with celiac disease & it may be considered that both these diseases are based on one common immunologic disorder.
- The association between ***pulmonary hemosiderosis*** & celiac disease have been reported 9 times in literature as an extremely rare combination.

Other Presentations of Celiac Disease:

- ***Neurological*** symptoms e.g., ***peripheral neuropathy***, ***ataxia*** or ***epilepsy.***
- ***Apthous ulcers*** in the mouth is considered to be an autoimmune disorder associated with celiac disease.
- ***Dental enamel defects*** are frequent.
- Patients with celiac disease may have ***liver diseases. Abnormal liver tests*** are common at diagnosis & usually improve with treatment.

Diagnosis: Serology

- ***Serum IgA endomysial antibodies (EMA)*** & ***serum IgA tissue transglutaminase (tTG) antibodies*** have both ***sensitivity*** & ***specificity > 95%.***
- Testing for ***gliadin antibodies*** is no longer recommended because of its ***low sensitivity*** & ***specificity*** for celiac disease.
- The ***tTG antibody*** is the ***recommended single serologic test*** for ***celiac disease screening.***

Diagnosis: Small Bowel Biopsy

- Required to confirm the diagnosis of celiac disease.
- Should also be considered in patients with ***negative serologic*** test results who are at ***high risk*** or in whom the physician ***strongly suspects*** celiac disease.
- Mucosal changes may vary from ***partial*** to ***total villous atrophy***, or may be characterized by ***subtle crypt lengthening*** or ***increased epithelial lymphocytes.***
- To avoid false-negative results on endoscopic biopsy, it is recommend to obtain at least ***4 tissue samples*** to increase the sensitivity of the test.

Dietary Management in Celiac Disease

- At present, the only effective treatment is a ***life-long gluten-free diet (GFD).***
- No medication exists that will prevent damage or prevent the body from attacking the gut when gluten is present.
- Strict adherence to the diet allows the intestines to heal, leading to resolution of all symptoms in most cases and, depending on how soon the diet is begun, can also eliminate the increased risk of complications.

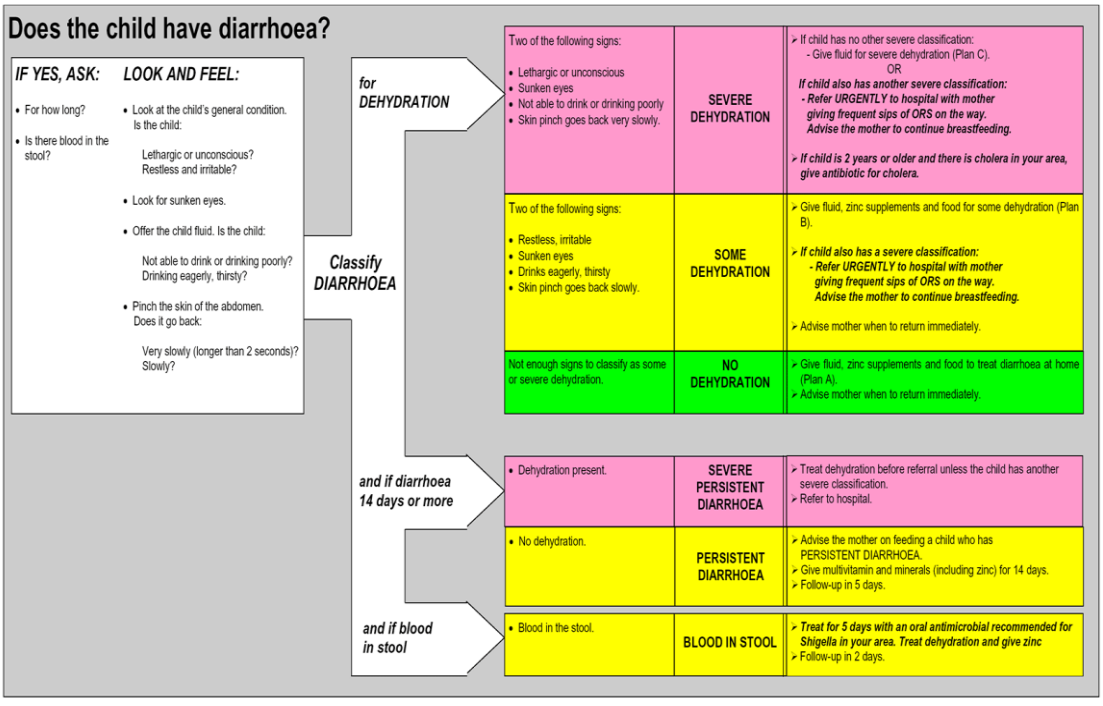
Follow-Up:

- Serologic markers ***(serum IgA tTG)*** used to monitor ***compliance*** with GFD.
- ***Antibody levels*** return to ***normal*** within ***3-12 months*** of starting a GFD but may take up to ***30 months*** if the initial titers are high.
- ***Repetition of small bowel biopsy 3-4 months*** after initiation of a GFD is ***not necessary*** if the patient responds appropriately to therapy.
- If the patient does not respond as expected → revise the patient's adherence to GFD, then the physician should consider other differential diagnosis.

American Gastroenterological Association Institute Recommendations for Celiac Disease Screening

Consider testing in symptomatic patients at high risk for Celiac Disease with any of the following conditions:

- Autoimmune hepatitis
- Down syndrome
- Premature onset of osteoporosis
- Primary biliary cirrhosis
- Unexplained elevations in liver transaminase levels
- Unexplained iron deficiency anemia
- Type 1 DM



Plan B (Some Dehydration)

1. Daily fluid requirement:
   - Up to 10 kg = 100 ml/ kg
     10 – 20 kg = 50 ml/ kg
     > 20 kg = 20 ml/ kg

2. Deficit replacement:
   75 ml/ kg ORS to be given over 4 hours

3. Replace losses:
   ORS should be administered in volumes equal to diarrheal losses. Maximum of 10 ml/ kg per stool.

4. Give Supplemental Zinc (20 mg) to the child, everyday for 10 to 14 days

Volume/Time - IV Drop Rate Questions

Given a certain amount of liquid, a time period, and a drop factor (gtts/mL), what is the necessary IV flow rate in gtts/min? Measurement used when IV is regulated manually. Because it is not possible to give a patient a fraction of a drop, it is typical to round answers for these problems up or down to the nearest whole number.

Formula:

$$\frac{\text{Volume (mL)}}{\text{Time (min)}} \times \text{Drop Factor (gtts/mL)} = \text{Y (Flow Rate in gtts/min)}$$

Example: Calculate the IV flow rate for 1200 mL of NS to be infused in 6 hours. The infusion set is calibrated for a drop factor of 15 gtts/mL.

$$\frac{\text{Volume (mL)}}{\text{Time (min)}} \times \text{Drop Factor (gtts/mL)} = \text{Y (Flow Rate in gtts/min)}$$

Convert 6 hours to minutes.

- min ← hr (x by 60)
- 6 hr x 60 = 360 min

$$\frac{1200 \text{ mL}}{360 \text{ min}} \times 15 \text{ gtts/mL} = \boxed{\textbf{50 gtts/min}}$$

Example: Calculate the IV flow rate for 200 mL of 0.9% NaCl IV over 120 minutes. Infusion set has drop factor of 20 gtts/mL.

$$\frac{\text{Volume (mL)}}{\text{Time (min)}} \times \text{Drop Factor (gtts/mL)} = \text{Y (Flow Rate in gtts/min)}$$

$$\frac{200 \text{ mL}}{120 \text{ min}} \times 20 \text{ gtts/mL} = \boxed{\textbf{33 gtts/min}}$$

Fluid Maintenance Requirement Questions

Given the weight of a child or infant, calculate the necessary amount of fluid per day. Different hospitals may have different policies, but for learning how to perform these pediatric dosage calculations, the following commonly used table of fluid requirements may be used.

Weight Range	Required Daily Fluid
0-10 kg	100 mL per kg
10-20 kg	1,000 mL + 50 mL per each kg above 10 kg

>20 kg	1,500 mL + 20 mL per each kg above 20 kg

Example: An infant weighs 4 kg. What is the required amount of fluid per day in mL?

0-10 kg	100 mL per kg

4 kg x 100 mL/kg = **400 mL**

Example: An infant weighs 14kg. What is the required IV flow rate in mL/hr to maintain proper fluid levels?
Convert 30.8 lb to kg.

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10-20 kg	1,000 mL + 50 mL per each kg above 10kg

14 kg - 10 kg = 4 kg (There are 4 kg over 10 kg).
1,000 mL + (50 mL/kg x 4 kg) = 1,200 mL/day
This is now an ordinary IV Flow Rate - mL Rate Question. The required volume is 1,200 mL and the time is one day.

$$\frac{\text{Volume (mL)}}{\text{Time (hr)}} = \text{Y (Flow Rate in mL/hr)}$$

There are 24 hours in one day.

- 1 day x 24 = 24 hr

$$\frac{1{,}200\ \text{mL}}{24\ \text{hr}} = \boxed{\mathbf{50\ mL/hr}}$$

A 6 month infant present with diarrhea and vomiting for 3 days associate with poor feeding and urine output his mother feed him bottle type give him 3 once of milk every 3 hours, mother mixes 3 once of water with 4cube of milk powder his weight 7 Kg by examination the baby lethargy, tachycardia , tachypnea,

Investigation done (blood urea 137 mg\dl , serum creatinine 1 mg\dl , random blood sugar 50 mg\dl , serum sodium 122mEq\l , serum potassium 2.2 mEq\l ,

1- Type of dehydration ?
2- What the first line of management ?
3- Who you calculate the total fluid requirement for this child in 24 hours?
4- Calculate the maintenance in drops for each hours ?

Answers

1- Hyponatremia dehydration
2- First ressesstate intravascular fluid by giving shoot (normal saline or ringer lactate) 20 cc per kilo gram (20cc *7 =140cc in half hours)
3- Total fluid requirement divided as maintenance and deficit

Maintenance 7*100=700 cc

Deficit 6*1000\100*7=420 cc

700+420=1120 cc in 24hours

4- 1120\ 24 =47 mile per hour
Each mile=15 drops