Malabsorption: causes, consequences, diagnosis and treatment

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Abstract

Malabsorption generally refers to the alterations of the gastrointestinal tract affecting the digestion, absorption and transport of nutrients across the bowel wall. In this article the causes, diagnostic tests and appropriate treatment options will be discussed by differentiating between premucosal, mucosal and postmucosal aberrations.

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Introduction

Malabsorption refers to alterations of the gastrointestinal tract (GIT) affecting the digestion, absorption and transport of nutrients across the bowel wall. Malabsorption is defined as intestinal absorption capacity falling short of 85%. It is regarded as an important clinical indicator of intestinal failure.[1] The latter refers to the inability of the GIT to digest and absorb sufficient nutrients to maintain the GIT mucosa integrity, fluid balance, nutritional status and overall health.[2]

Causes

The causes, diagnostic tests and treatment of malabsorption can be described in terms of premucosal, mucosal and postmucosal aberrations. Causes of premucosal malabsorption include diseases and conditions that result in impaired digestion (Table I). Such clinical settings include chronic pancreatitis, cystic fibrosis and pancreatic cancer, all of which are associated with inadequate pancreatic enzyme secretion as well as cholestatic liver disease and bacterial overgrowth that could lead to lack of solubilising bile salts. Causes of mucosal malabsorption include conditions that affect the gut mucosa itself, and result in a reduced absorptive area. Examples include coeliac disease, inflammatory bowel diseases and Whipple's disease. Lastly, the causes of postmucosal malabsorption comprise conditions that result in altered nutrient transport, i.e. vascular or lymphatic obstruction.[3,4]

Table I: Pathophysiology of malabsorption [3,4]

Premucosal
Impaired digestion
Bile acid/enzyme deficiencies
Mucosal
Reduced absorption
Bowel resection
Diseases affecting absorption
Postmucosal
Altered nutrient transport
Vascular or lymphatic abnormalities

Consequences

The consequences of malabsorption are directly linked to the extent and duration of the underlying causes. This may include abdominal pain and bloating (due to bacterial gas production and bacterial overgrowth), diarrhoea and steatorrhoea, fluid and electrolyte losses, anaemia (iron, folate and vitamin B_{12}), growth retardation and osteopenia (malabsorption of calcium, vitamin D, phosphate and magnesium results in secondary hyperparathyroidism).[3–5]

The overarching consequence of malabsorption is malnutrition. Because malnutrition can be regarded as an independent risk factor for morbidity and mortality, malabsorption is a condition that needs to be identified early and treated timeously. According to a recent article by Richard et al describing the consequences of malnutrition, hospitalised malnourished patients had a significantly greater risk of developing infectious complications, respiratory failure, cardiac arrest, cardiac failure, arrhythmias and wound dehiscence. The malnourished patients also had a significantly longer duration of hospitalisation, regardless of the underlying disease and its course of treatment. Furthermore, the risk for hospitalisation of longer than 12 days' duration is four to five times higher in malnourished patients.[6]

Diagnosis

Diagnostic tests to identify malabsorption also include those tests that can identify impaired digestion (premucosal), reduced absorption (mucosal) and altered nutrient transport (postmucosal; Table II). Serum levels of electrolytes, minerals and vitamins may

serve as a good proxy marker of nutritional status and hence low values can serve as an indicator of impaired digestion and premucosal malabsorption. A faecal fat excretion test is a simple and quick, albeit cumbersome, test to measure fat malabsorption, where a fat content of less than 7 g/day following a 100 g fat intake for 72 hours is regarded as normal. The only disadvantage is that the test cannot differentiate between enteric and pancreatobiliary causes of malabsorption.[1,3,4] The hydrogen breath test can be used to identify carbohydrate malabsorption. This test is based on the assumption that undigested carbohydrates will be fermented by colonic bacteria, resulting in the accumulation of hydrogen.[3,4] The gas is absorbed by the intestinal mucosa and excreted through the lungs. However, it is important to remember that about 18% of individuals are hydrogen nonexcretors,[4] and in such individuals the test results are unreliable. Various carbohydrates may be measured, but glucose and lactulose are probably most commonly used for the identification of bacterial overgrowth and hence carbohydrate maldigestion.[7,8] Irrespective of the type of carbohydrate used, exhaled hydrogen is measured in parts per million (ppm), and an increase of more than 20 ppm above baseline values is considered a positive result. The test results may be influenced by various factors, for example the use of antibiotics or laxatives, periods of fasting, diet over the previous 24 hours, and therefore adequate patient preparation before the test is important.[7,8]

Table II: Diagnostic tests for malabsorption[1,3–5,7,8]

Premucosal
Impaired digestion
Serum electrolyte, mineral and vitamin values
Faecal fat excretion, hydrogen breath test
Ultrasound for obstructions/calcifications
Mucosal
Reduced absorption
Bowel resection
Endoscopy and histology
Xylose test, Schilling test
Postmucosal
Altered nutrient transport
Ultrasound/contrast for fistulae

A reduced absorptive area and mucosal malabsorption (Table II) may result from surgical bowel resection and/or disease-induced impaired absorptive capacity (flattening of the villi), which can be detected through endoscopy and histological examination of small bowel biopsies. Vitamin B_{12} deficiency may develop as a result of gastric diseases (gastrectomy or gastritis) or diseases affecting the terminal ileum (resection or inflammatory diseases, i.e. Crohn's disease).

A Schilling test, with and without adding intrinsic factor (IF), can be used to identify vitamin B_{12} malabsorption. Radio-labelled vitamin B_{12} is ingested and the urinary excretory levels are measured. A decreased urinary vitamin B_{12} level is indicative of malabsorption. If gastric diseases are the cause of the deficiency, co-administration of IF will correct the deficiency. However, if it remains low, even when IF was added, malabsorption in the terminal ileum should be suspected.[3,5] It is important to remember that the reliability of the test results is questionable in patients with impaired renal function.[5]

Carbohydrate absorption can be measured through the amount of xylose excreted in the urine over a five-hour period, because xylose is a form of carbohydrate that is not metabolised. This test can differentiate between pancreatic and enterocyte-related causes of carbohydrate malabsorption. Results of this test will be normal in carbohydrate malabsorption of pancreatic origin thus differentiating it from enterocyte malfunction.[3]

Postmucosal malabsorption due to altered nutrient transport can best be detected through ultrasound testing and contrast radiography for fistulae.

Treatment

The treatment plan for malabsorption must be, by necessity, cause specific,[3] with appropriate adaptation to a diet that would best support a given setting. For instance, pancreatic enzymes may be added to food to aid its absorption. Normally between 25 000 to 40 000 IU of lipase is required per meal. However, this dose should be titrated against the clinical response. For best results it is recommended that meals should be divided into five or six smaller meals throughout the day. A lipase dosage in excess of 75 000 IU per meal is not recommended.[9] In the case of altered nutrient transport caused by obstruction, surgery is the best option (Table III).

Table III: Treatment of malabsorption

Premucosal
Impaired digestion
Partially digested food
Pancreatic enzyme supplementation
Surgery for obstruction
Mucosal
Reduced absorption
Partially digested food
Disease-specific treatment
Postmucosal
Altered nutrient transport
Surgery for obstruction

The malabsorption index[10] is a simple, validated tool to assess the level of malabsorption on clinical grounds. It takes into consideration six different variables: stool frequency and consistency, usage of medication that promotes gastrointestinal transit, nutritional status (weight loss), medical diagnosis (specifically inflammatory conditions), treatment and procedures (gastrointestinal surgery or radiation treatment) and serum albumin concentration (Table IV). Based on the total points scored, the degree of malabsorption is indicated as none, moderate, high or very high, and a recommended nutritional therapy is suggested accordingly (Table V). The latter is based on the manipulation of the food components from whole nutrients to medium-chain triglycerides and peptide-based diets to total parenteral nutrition.[10]

Table IV: Malabsorption index: scoring system[10] (reproduced with permission)

MALABSORPTION INDEX

Please indicate the relevant score next to each of the following 6 variables and tally the final score.

1	**Stool Frequency and Consistency** Frequency of diarrhea and/or loose stools			
	Daily (4 points)	> 3 times per week (3 points)	Rarely (0 points)	
2	**Medication** Is the individual on any medication that promote rapid intestinal transit and/or that control stools?			
	Yes (3 points)	No (0 points)		
3	**Nutritional status** Is the patient experiencing weight loss despite the provision of a reasonable level of calories (25-35 kcal/kg) and protein (> 1 g protein/kg/day)?			
	Yes (3 points)	No (0 points)		
4	**Medical diagnosis** Diagnosis of any of the following diseases in the past 12 months: Crohn's disease, Ulcerative colitis, Pancreatitis; Short bowel syndrome; Bacterial overgrowth; AIDS enteropathy; Liver disease			
	Yes (3 points)	No (0 points)		
5	**Treatments and Procedures** Treatments received in the past 6 months: Radiation therapy in the GIT; Intestinal resections; Gastrectomy			
	Yes (3 points)	No (0 points)		
6	**Serum albumin** Serum albumin value in the past 2 months			
	< 20 g/L (4 points)	21 – 25 g/L (3 points)	26 – 30 g/L (2 points)	> 30 g/L (0 points)
TOTAL POINTS				

Table V: Malabsorption index: implementation[10]

Total points	Degree of malabsorption	Recommended nutritional therapy
0	Low	Utilise whole protein diet
2–6	Moderate	[a]MCT-containing whole protein-based diet, advanced to peptide-based diets if not tolerated
7–14	High	Use peptide-based MCT-containing diets; if <60% goal achieved, advance to [b]TPN
15+	Very high	TPN with/without elemental diet

a = medium-chain triglycerides, b = total parenteral nutrition

The treatment of the patient with malabsorption and impaired serum electrolyte and mineral levels should include a high degree of suspicion in order to prevent refeeding syndrome. The latter refers to the potentially fatal shifts in fluids and electrolytes that may occur in malnourished patients upon reintroduction of food.[11] The classical biochemical picture is that of hypophosphataemia, hypokalaemia, hypomagnesaemia, abnormal sodium and fluid balance, and thiamine deficiency.[11,12] Patients at risk of developing refeeding syndrome should be identified before the onset of feeding (Table VI). Frequent monitoring (daily if necessary) and correction of serum electrolytes and mineral concentrations is essential. Furthermore, the introduction of nutrition should be slow and controlled, even if it means that the full nutrient and energy requirements may only be reached after seven to 10 days.[11,12]

Table VI: Patients at high risk of developing refeeding syndrome[11,12]

Unintentional weight loss
> 5% body weight over one month or > 10% body weight over six months
Low or inadequate nutrient intake
Hypocaloric feeding Starvation Anorexia nervosa Chronic alcoholism Elderly Oncology patients Postoperative patients
Increased nutrient losses or decreased absorption
Excessive diarrhoea Excessive vomiting Chronic pancreatitis Gastrointestinal surgery Gastrointestinal inflammatory conditions Uncontrolled diabetes mellitus Chronic use of laxatives, diuretics or antacids

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