

# Malabsorption



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## The gastrointestinal tract and absorption

The normal adult small intestine measures approximately 400 cm in length and consists of the duodenum (25-30 cm), the jejunum (160-200 cm) and the ileum (170-215 cm). Most carbohydrate and protein absorption takes place in the duodenum and jejunum, whilst the ileum is responsible for absorbing fats attached to bile salts, fat-soluble vitamins, and vitamin B12. Most fluids and electrolytes are absorbed in the ileum and the large intestine.<sup>1</sup>

## Malabsorption

Diagnostic features of malabsorption include: weight loss, anaemia, diarrhoea, changes in stool frequency/volume, malodorous stools, flatulence, steatorrhea, abdominal distension, osteoporosis, fat soluble vitamin deficiency, vitamin B12 deficiency, electrolyte disturbance, zinc and magnesium deficiency.<sup>2,3,4,5</sup>

This article will discuss features of malabsorption and nutritional, as well as medicinal, recommendations.

## Fat malabsorption/steatorrhea

This can be diagnosed by the presence of pale, greasy, unformed, difficult to flush, malodorous, poorly formed and frothy stools. It may

occur due to pancreatic insufficiency (pancreatitis, cystic fibrosis), bypass of the duodenum, resections of the jejunum and/or ileum, or insufficient bile salts (liver cirrhosis, primary sclerosing cholangitis).<sup>2,3,5</sup>

## Treatment

Pancreatic enzymes are required at the start of the meal and sometimes again during the meal. In practice, doses are usually adjusted based upon symptom reports of steatorrhea and weight.

- 500-2500 units of lipase per kg body weight per meal
- ≤ 10 000 units of lipase per kg/body weight per day
- ≤ 4 000 units of lipase per g of dietary fat per day.<sup>6</sup>

Food fortification and oral nutritional supplements may be required if diet with pancreatic enzyme therapy alone is not enough to restore the patient's nutritional status, and medium chain triglycerides (MCT) should be considered if enzyme therapy proves insufficient to allow symptom relief and maintenance of an adequate nutritional status/BMI. In some cases up to 30 per cent MCT in the diet is required (see **Tables One & Two**).<sup>5</sup> The use of fat-free juice-based supplements (see **Table Three**) may be useful in this instance. A reduction in dietary fat of 50 per cent or 0.5 g/kg body weight may also be considered.<sup>7</sup> Fat soluble vitamin supplementation may be required, and hypocalcaemia may also occur as a result of vitamin D deficiency.

It is important to monitor the bowel movements and the patient's weight when evaluating treatment.

### Carbohydrate malabsorption

Carbohydrate malabsorption manifests as copious watery osmotic diarrhoea, abdominal distension and flatulence. The main reason for carbohydrate malabsorption is the absence or deficiency of lactase.<sup>2</sup>

Hereditary alactasia (rare but severe) occurs from birth and requires total lactose exclusion due to the complete absence of the enzyme lactase.<sup>2</sup>

Primary lactase deficiency is an autosomal recessive disorder, where a gradual reduction in lactase activity causes symptoms in older children and adults. Some lactose can be tolerated and as such it is important to determine where the threshold lies. It is especially common in people whose genetic origins lie in countries where the consumption of milk after weaning is generally uncommon.<sup>2</sup>

Secondary lactase deficiency is transient, common in newly diagnosed coeliac disease patients and after severe gastroenteritis.<sup>2</sup>

#### Treatment

Initially all sources of lactose should be removed and then reintroduced slowly. With secondary lactase deficiency the lactose content of the diet may be worth increasing again after three to nine months. Symptoms may be less likely to occur if the lactose is consumed as part of a solid meal as opposed to a glass of milk, probably as a result of delayed gastric emptying. Furthermore, lactose present in fermented milk products, such as yoghurt, may also be better tolerated due to the partial ability of the bifidobacteria to metabolise lactose.<sup>2</sup>

Since dairy intake is reduced, or eliminated, there is a greater risk of osteoporosis developing; those with family history of osteoporosis, coeliac disease or low BMI are at an increased risk. Zinc and magnesium deficiency may occur with prolonged diarrhoea and supplementation may be required to make up for the reduced absorption and increased losses.<sup>1</sup>

### Gastrectomy with Roux-en-Y reconstruction

After subtotal or total gastrectomy with Roux-en-Y reconstruction patients may exhibit steatorrhea. This is due to a combination of reduced gastric lipase, exocrine pancreatic insufficiency, pancreaticobiliary asynchrony and small bowel bacterial overgrowth.<sup>3</sup>

Fat malabsorption occurs in patients with small bowel bacterial overgrowth primarily because excess bacteria in the small bowel deconjugate bile salts and alter micelle formation. Treatment with antibiotics periodically may be required. It is suggested to use three to four different antibiotics on a rotational basis to reduce the incidence of antibiotic resistance.<sup>8</sup>

Anaemia due to vitamin B12 deficiency, iron and folate may also occur.<sup>9-11</sup> Gastric acid, under normal circumstances, would release vitamin B12 from its protein complex and intrinsic factor which is secreted by the stomach and allow for its absorption in the terminal ileum. With both of these mechanisms impaired so is the absorption of vitamin B12. Small bowel bacterial overgrowth further interferes with the absorption of vitamin B12. Vitamin B12 injections should be prescribed routinely following total gastrectomy. Oral B12

supplementation may be considered for subtotal gastrectomy patients, 1000-2000 µg daily may be required.<sup>3</sup>

Iron is mostly absorbed in the duodenum, which is bypassed in the case of Roux-en-Y reconstruction. Also the decrease in gastric acidity or its absence does not allow for iron to be converted into its more readily absorbable form (from ferric ions to ferrous ions). Iron deficiency is best treated with 200 mg elemental iron a day.<sup>3</sup> This should be given three times a day, six hours apart, alongside a source of vitamin C to enhance the absorption. Patient compliance can be an issue with iron supplementation due to its side-effects, which include nausea and constipation.<sup>3</sup>

Vitamin D deficiency and bone disease have been frequently reported following gastrectomy.<sup>12,13</sup> Calcium is primarily absorbed in the duodenum, which is bypassed with Roux-en-Y reconstruction, and fat malabsorption may lead to the formation of calcium soaps which are excreted faecally.

#### Treatment

Follow guidelines for steatorrhea (as previously discussed), with the use of pancreatic enzyme therapy. Test for small bowel bacterial overgrowth if suspected and treat if present. Recommend a high energy and protein diet as well as a multivitamin.<sup>3</sup>

Table One: MCT Sip Feeds & Shots

	Presentation	Kcal/ml	Protein g/ml	MCT%
Survimed® OPD Drink	200 ml bottle	1.0	0.05	47.5
Peptamen® Vanilla Bottle	200 ml bottle	1.0	0.04	67.6
Vital® 1.5kcal	200 ml bottle	1.5	0.07	63.6
Fresubin 5kcal Shot	120 ml bottle	5.0	0	25.8
Liquigen	250 ml bottle	4.5	0	96.4
MCT Peptide 1+	400 g can	0.9	0.03	75

Table Two: MCT Enteral Tube Feeds

	Presentation	Kcal/ml	Protein g/ml	MCT%
Fresubin® HP Energy	Easybag	1.5	0.08	56.9
Reconvan®	Easybag	1.0	0.06	57.6
Survimed® OPD	Easybag	1.0	0.05	51.4
Survimed® OPD HN	Easybag	1.33	0.07	51.9
Modulen®	Tin	1.0-1.5	0.04-0.05	25.5
Peptamen® HN	Smartflex™	1.3	0.07	69.4
Peptamen® AF	Smartflex™	1.5	0.09	52.3
Peptamen®	Smartflex™	1.0	0.04	70.3
Nutrison Peptisorb	Glass bottle	1.0	0.04	47.1
Nutrison MCT	Glass bottle	1.0	0.05	60.6
Vital® 1.5kcal	RTH bottle	1.5	0.07	63.6
Perative®	RTH bottle	1.3	0.07	40
MCT Peptide 1+	400 g can	0.9	0.03	75

Table Three: Fat-free Sip Feeds & Shots

	Presentation	Kcal/ml	Protein g/ml	Fat g/ml
Ensure Plus juice	220 ml bottle	1.5	0.05	0
Fresubin Jucy Drink	200 ml bottle	1.5	0.04	0
Fortijuce	200 ml bottle	1.5	0.04	0
Resource® Fruit	200 ml bottle	1.3	0.04	0
ProSource Liquid	30 ml pouch	3.3	0.33	0

## Intestinal resections

Intestinal resections may be required due to cancer, IBD, obstruction, ischaemia or injury. The treatment required will depend on the site and extent of the resection. It is important to consider the function of the bowel which is removed.

## Jejuno-colic anastomosis

The resection of the ileum leads to malabsorption of vitamin B12, bile acids, fat and fat soluble vitamins, calcium and magnesium. The presence of the colon allows water and sodium absorption.

- $\geq 100$  cm jejunum remaining + colon = diet +/- supplements
- 50-100 cm jejunum remaining + colon = diet + supplements
- $\leq 50$  cm jejunum remaining + colon = PN<sup>14</sup>

### Treatment

A high energy (30-60 kcal/kg/day), high carbohydrate (60%), high protein (20%), and low-moderate fat (20%) treatment – a proportion of which should be MCT – that can be absorbed in the colon (see **Tables One and Two**). Treatment also needs to be adjusted according to steatorrhea. A low fat diet results in reduced diarrhoea, reduced losses of calcium and magnesium (see **Table Three**).<sup>2</sup> Vitamin B12 injections may be required and a multivitamin may help to compensate for reduced absorption and increased losses.

## Jejunostomy

Loss of ileum and colon leads to fluid and electrolyte depletion and faster transit times. This should be managed with anti-secretory drugs or anti-motility agents. There is malabsorption of macronutrients, vitamin B12 and bile acids, fat and fat soluble vitamins, which leads to weight loss and malnutrition. The sodium concentration of the jejunum determines the ability to absorb fluid; only at levels above 90 mmols/l does the jejunum initiate fluid uptake.<sup>14, 15, 16</sup>

- $\geq 100$  cm jejunum remaining = diet +/- fluid and electrolytes
- $\leq 100$  cm jejunum remaining = PN + diet<sup>14, 17</sup>

### Treatment

- High energy 30-60 kcal/kg/day, high protein 20%, high fat 60%, low fibre
- Stoma output  $\leq 1200$  ml/day can maintain sodium balance by adding salt to food
- Stoma output  $\geq 1200$  ml/day will need an oral sodium supplement ( $\geq 90$  mmol sodium/l).<sup>16, 17, 18</sup>

Salt and salty foods should also be recommended to increase the sodium concentration of the jejunum. The optimal sodium concentration of oral fluids should be above 90 mmols/l. Patients will often complain of feeling thirsty but the more hypotonic liquids will in fact contribute to increased stomal losses. An oral fluid restriction of  $\leq 500$  mls/day may also be required.<sup>17</sup> When enteral feeding is occurring 10 mls of 30 per cent sodium chloride (50 mmols) may be added to the feed; however, it should be noted this goes against the manufacturers' guidelines.<sup>16, 19</sup>

Undernutrition is common in patients with high output stomas due to the nutrients which can no longer be absorbed efficiently. Food fortification and oral nutritional supplements should be used as first line therapy. Fibrous foods are more difficult to digest and, as such, should be limited in the first instance. Once the gut is working more efficiently, fibre may be reintroduced slowly.<sup>15</sup> Certain foods help to thicken up the stomal output: apple sauce, marshmallows, peanut butter, white rice and white bread.

Drug therapy may also be required to reduce stomal output – see **Table Four**.

## Ileal resections

Resections involving the loss of more than 100 cm of ileum frequently lead to severe problems with malabsorption. When the ileum is resected the colon receives a much larger load of fluid and electrolytes and, also, receives bile salts which reduces its ability to absorb salt and water, resulting in diarrhoea. In addition, bile salt deficiency leads to steatorrhea (see before for further details on steatorrhea management).<sup>1</sup>

### Treatment

These patients can be managed with a low-fat diet and a bile-salt binding resin, such as cholestyramine.<sup>1</sup>

## Pancreatic insufficiency

This may occur following partial resection of a diseased pancreas, with advanced chronic pancreatitis, or with a resection of 90-100 per cent. The lack of lipase and protease accounts for the malabsorption and this can be reversed with accordingly titrated oral administration of pancreatic enzymes (see before for further details on pancreatic enzymes). Total pancreatectomy, in addition to the nutritional consequences, also leads to diabetes.<sup>5</sup>

### Treatment

Reduction in dietary fat to levels tolerated alongside pancreatic enzyme therapy, inclusion of medium chain triglycerides (see **Tables One and Two**) and consideration of dietary modification for diabetes control.<sup>5</sup>

## Hepatobiliary disease

Biliary obstruction with jaundice, bile diversion as with drainage of the common bile duct with a T-tube, or bile loss from a biliary fistula, all result in fat malabsorption due to loss of bile salts from the digestive tract.<sup>5</sup> Associated with the fat malabsorption is the malabsorption of vitamins A, D, E and K, as well as the malabsorption of calcium, as in the presence of fat malabsorption calcium is bound to form soaps which are excreted faecally.

### Treatment

Steatorrhea may be controlled by reducing the fat content of the diet and supplementation of the fat soluble vitamins A, D, E and K as well as calcium may be required.<sup>1</sup>

## Summary

- Treat primary disorder
- Provide symptomatic relief
- Correct fluid and electrolyte losses
- Restore nutritional status
- Check vitamin and mineral statuses: A, D, E, K, B12, folate, iron and zinc.

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Table Four: Drug Therapy

Class of Drug	Action	Generic Name	Dose	Miscellaneous
Anti-motility	Reduce intestinal motility and sodium/water losses by 20-30%	Loperamide	4 mg QDS (higher doses may be needed – up to 24 mg QDS)	Both Loperamide and Codeine Phosphate may be used together. Loperamide should be given 30-60 mins prior to eating and the capsule may need to be opened
		Codeine phosphate	60 mg QDS	
Anti-secretory	Reduce gastric acid secretions	Cimetidine	400 mg od	Reduce jejunostomy output particularly in those with $\geq 21$ /day stomal losses
		Ranitidine	300 mg bd	
		Omeprazole	40 mg od	
		Octreotide	50 µg bd	
				Given subcutaneously and is painful + very expensive

Adapted from Nightingale J, Woodward JM. Guidelines for the management of patients with a short bowel.