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GUIDELINE

Nutritional Management in the Compromised Gut: Short Bowel Syndrome, Enterocutaneous Fistula, and Stoma

Gourav Kaushal[1], S Anand[2]*, Raksha Ranjan[3], Ridashisha Bani[4]

1 Assistant Professor, Department of Surgical Gastroenterology, Department of Paediatrics, AIIMS Bathinda, Punjab, India
2 Consultant minimally invasive GI and HPB surgeon, Apollo main hospital, Greams road, Chennai, India
3 Assistant Professor, Department of Paediatrics, Adesh Institute of medical sciences and Research, Bathinda, Punjab, India
4 Nursing officer, Department of Surgical Gastroenterology, AIIMS Rishikesh, Uttarakhand, India

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* **Corresponding author**.

kssa.5149@gmail.com

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Abstract

Nutrition in patients with a compromised gut is a challenge requiring a multidisciplinary management and necessitates individualized nutritional planning. Intestinal failure is defined as significant deficit in gut absorption of micro and macronutrients such that intravenous supplementation is necessary to sustain life. If absorption is inadequate, however intravenous supplementation is not required, it is called intestinal insufficiency. Short bowel syndrome and entero cutaneous fistula are the most common conditions leading to intestinal insufficiency and failure. These conditions in the initial phase may lead to significant loss of fluids and electrolytes and require multidisciplinary team management. Definite plan for restoration of adequately functioning bowel after stabilization of patient is important. Based on evidences, recommendations for nutritional management in such patients were thoroughly discussed and approved by the Gastrointestinal nutrition core committee of the Indian Association of Parenteral and enteral nutrition (IAPEN).

Keywords: Short bowel syndrome; Enterocutaneous fistula; Nutrition

Short Bowel syndrome

Short-bowel syndrome results from loss of bowel length and is characterized by the inability to maintain protein-energy, fluid, electrolyte, or micronutrient balances when on a conventionally accepted, normal diet [1,2]. It may arise secondary to surgical resection, a congenital defect, or disease-associated loss of absorption. In general, a small bowel length of < 200 cm is considered the criteria to define short bowel syndrome [3]. Multiple factors aside from the remaining bowel length influence the need for parenteral and enteral nutritional supplementation, like the type of bowel remaining (jejunum, ileum),

presence or absence of ileocecal valve, and degree of intestinal adaptation. Short bowel patients pass through various phases, and the problems and management are unique to each phase. The acute phase starts immediately after resection and usually lasts for 3-4 weeks; it is characterized by fluid and electrolyte imbalance, and management primarily focuses on rehydration and correction of dyselectrolytemia. Next comes the adaptation phase, which encompasses structural and functional changes in the bowel to optimize nutritional absorption; it may last up to one to two years. Successful management of these patients aims to provide adequate nutrition, water, and electrolytes to maintain normal body weight and function, preferably provided by the oral or enteral route, thereby achieving a good quality of life.

Recommendation 1.1: Importance of gut anatomy

• Patients with retained ileum and colon do not often need long term nutritional supplementation.
• Patients with jejunostomy are challenging to manage and are likely to need parenteral or enteral fluid and nutritional supplementation.

One of the significant determinants of nutritional autonomy after surgery is the anatomy of the remaining bowel[4,5]. Three anatomies have been described based on the presence or absence of the colon and ileum. Patient can have end jejunostomy, jejunocolonic anastomosis and jejuno-ileo-colonic anastomosis. Among these, End jejunostomy patients are most challenging to manage and are likely to require oral or parenteral nutritional supplementation; jejuno-ileo-colonic patients carry the best prognosis and are unlikely to require supplementation in the long term. Continuity of the bowel should be restored at the first opportunity to convert the anatomy to a more favorable type.

Recommendation 1.2: Protein-energy malnutrition

• Frequent high-energy feeds should be taken, and food should be chewed well.
• Oral sip feeds in between meals can help increase overall caloric intake.
• Parenteral nutrition supplementation may be required if optimal oral and enteral feeds fail to regain weight.

Undernutrition is a common problem in these patients, and pre-emptive measures should be taken to avoid it. The patients on an oral diet should be advised to take energy-rich food frequently; further oral sip feeds in between meals can enhance overall energy intake. If these measures are insufficient, night-time feeds, either through a nasogastric or percutaneous gastrostomy, can be administered until the daily nutritional goals are met with day feeds. Supplementary parenteral nutrition may be required, especially in the initial phases or if there is weight loss despite optimization of oral and enteral feeds, or if there is an unacceptable increase in stomal losses/diarrhea on increasing enteral feeds.

Recommendation 1.3 : Dietary composition

• Jejunostomy patients should take a high-fat diet along with complex carbohydrates.
• Medium-chain triglycerides are preferred in jejunum-colon patients; essential fatty acids should be supplemented is required.
• Jejunum–colon patients should be given a high carbohydrate, restricted fat (Long chain fatty acid] diet.

High fat, precisely long-chain fatty acids, reduces transit time, sodium, and water absorption and may cause diarrhea in jejunum-colon patients[6,7]. Medium-chain triglycerides can be used instead in jejunum-colon patients as these are better tolerated and do not cause diarrhea. However, essential fatty acids should be supplemented using sunflower or safflower oil. In jejunostomy patients, high fat can be given as fat yields almost twice the energy of carbohydrates and tastes better.

Recommendation 1.4: Salt and water management

• Hyponatremia is common in Jejunostomy patients; glucose saline supplementation and salt capsules are helpful.
• Potassium and magnesium supplementation required occasionally.

Owing to the excellent capacity of the colon to absorb sodium and water, patients with preserved colon rarely need water and sodium supplementation[8,9]. On the other hand, patients with jejunostomy often have high stoma output rich in sodium (100 mmol/l), thus often leading to hyponatremia[10]. Adding sodium chloride to any liquid given helps replace the losses; additional sodium may be provided by encouraging oral sips of glucose saline solution throughout the day. Sodium concentration in the supplementary fluid should be around 90 mmol/l, and the addition of glucose helps in enhanced absorption of both sodium and water[11]. This glucose saline solution can be easily prepared at home by adding six level teaspoons of sugar, and a half-level teaspoon of salt to one liter of clean water[12], or WHO recommended ORS solution available commercially can be used. Sodium chloride capsules containing about 500 mg of salt in each can be given orally but may occasionally be not well tolerated owing to nausea caused by high intake. Rehydration and resulting correction of secondary hyperaldosteronism is the first step in correcting hypokalaemia and hypomagnesemia, but the patients may need oral potassium chloride or magnesium oxide supplementation; occasionally, intravenous supplementation may be required.

Vitamin B12 absorption is impaired in patients without ileum, and monthly supplementation with methylcobalamin

Recommendation 1.5: Vitamin and mineral supplementation

- **Vitamin B 12 supplementation is required regularly, other water-soluble vitamin deficiency is not common.**
- **Fat soluble vitamins (vitamin A, D, E and K] need replacement.**
- **Trace element supplementation is important, and more than usual doses are required.**

injections is required. Serum levels of vitamins and trace elements should be measured at admission and yearly after that; more frequent testing may be needed if there is documented deficiency[13]. Water soluble vitamin deficiency is uncommon as most of these are absorbed in the proximal jejunum. Typical doses of the various vitamin and trace element supplementation in SBS patients are depicted in Table 1. Typical doses are much higher than those required for an individual with a normal gut.

Table 1. Typical supplementation of vitamins and minerals in patients with SBS, adopted from AGA clinical practice update 2022[13]

Micronutrient	Typical Supplementation
Vitamin A	5-50K IU daily
Vitamin B12	1000mcg I/M monthly
Vitamin C	200-500 mg/day
Vitamin D	60000 IU weekly
Vitamin E	400 IU 1-3/ day
Folate	1 mg daily
Iron	100-200 mg/day
Zinc	10-50 mg elemental zinc
Selenium	100-200mcg daily
Chromium	100-200 mcg
Copper	2mg elemental copper
Multivitamins	1-2 capsules daily

Recommendation 1.6: Management of diarrhea/high stoma output and dehydration

- **Restrict oral hypotonic/ hypertonic fluids.**
- **Encourage oral glucose saline solution.**
- **Antimotility, e.g. loperamide and antisecretory (H2 blockers or proton pump inhibitors and octreotide) drugs can reduce the losses.**

Stoma output is driven by oral intake. In patients with jejunostomy, oral intake of hypotonic (water, tea, coffee, or alcohol) and hypertonic (fruit juices and soft drinks) fluids can increase the output and are best restricted[14]. If the output is very high (>4 L/day), oral intake should be stopped, and intravenous fluid supplementation should be given. Separating liquids and solid intake is advised, but the benefit is debatable. In marginally high stoma outputs (1.2-2L/day), oral hypotonic fluid restriction and glucose saline/ salt capsule supplementations usually suffice to maintain fluid and electrolyte balance[15].

Drug therapy is important, especially in the initial hypersecretory phase of SBS. The drugs are administered before meals. In patients with short lengths of remaining bowel, where tablets may come out unchanged, the drug may be crushed or mixed with liquids or food to enhance absorption[16]. Antimotility drugs like loperamide and codeine reduce intestinal motility and decrease the output from the stoma. Loperamide is preferred over codeine as it is less addictive. Loperamide is given initially as 2 milligrams before meals and can be increased up to 24 milligrams per day, according to the response[17].

Antisecretory drugs effectively reduce the output if the output is net secretory and high (>2L/day). Drugs like ranitidine and proton pump inhibitors (omeprazole, pantoprazole, rabeprazole, etc.) are absorbed in the proximal jejunum and are administered once or twice orally per day; occasionally, parenteral administration may be required if the jejunal length is < 50 cm[17]. Octreotide and its analogues reduce stoma output in high-output patients[18,19].

Recommendation 1.7: Gallbladder stones

- **Equally prevalent in jejunostomy and jejunum colon patients.**
- **Preventing biliary stasis and reducing lithogenicity of bile may help.**

The incidence of Gall stones in SBS patients can range between 20-45 % and is similar in both jejunostomy and jejunum colon patients[20,21]. Decreased oral intake and parenteral nutrition promote biliary stasis due to reduced cholecystokinin and promote gallstone formation[21]. Small bowel length of less than 120 cm and the need for parenteral nutrition are independent risk factors for gallstone formation. It usually occurs in the first two years after bowel resection[21]. The absence of ileum leads to impaired enterohepatic circulation of bile acids, thereby leading to supersaturation of bile with cholesterol[22,23]. Oral feeds rich in fat, ursodeoxycholic acid therapy, and Cholecystokinin injections have all been suggested to prevent gallstone formation[24]. Some studies have suggested prophylactic cholecystectomy at the time of massive bowel resection, but it is not a common practice currently[25,26].

The prevalence of renal stones is 25% in jejunum colon patients[20]. Stones are formed due to fat malabsorption leading to increased availability of free fatty acids to bind to calcium resulting in an increased concentration of unbound

Recommendation 1.8: Renal stones

- **Presence of colon in SBS increases the incidence of oxalate renal stones.**
- **Avoiding dehydration and diet low in oxalate may help in prevention.**

oxalate, which is absorbed from the colon and forms renal stones[27]. Oxalate stones can be prevented by adequate hydration and avoiding food rich in oxalate, e.g., tea, spinach, rhubarb, beetroot, chocolate, wheat bran, and strawberries[28]. A calcium-rich diet can help reduce oxalate absorption and prevent stone formation[29].

1.9 Parenteral nutrition

Parenteral nutrition (PN) for SBS is required in the acute phase in a majority of patients. In patients unable to meet adequate hydration and nutritional requirement through the enteral route, long-term PN may be needed either as a supplement to enteral nutrition or as total parenteral nutrition[30].

Recommendation 1.9.1:Initiation of PN

- **Nutritional assessment can be done by indirect calorimetry, using formulas or simply by using the actual or ideal body weight.**
- **Adequate provisions for extra calories and proteins should be made in acute phases of illness (1.2-1.5 times the normal).**
- **Electrolytes, trace elements, and vitamins should be added to meet daily needs and cover losses.**

The caloric requirement is usually calculated either by the Harris-Benedict equation or by ideal or actual body weight, as indirect calorimetry is not commonly available[31]. Approximately 25 kcal/day is sufficient for an average patient, but in acute stress, estimated requirements can be multiplied by a factor of 1.3-1.5, and up to 35 kcal/kg/day may have to be given[32]. In obese or underweight patients, calculations are done according to ideal body weight, as calculations by actual weight are inaccurate[33].

The next step is to decide the proportion of each macronutrient, i.e., protein, fats, and carbohydrates. The usual protein requirement is 1gm/kg/day, but it may be increased to 1.5/kg/day or higher in acute stress or active losses[30,32]. Nonprotein calorie needs are divided among carbohydrate and lipid sources. In general, 60-70% of calories should be supplied by carbohydrates and 30-40% by lipids. The lipid content should contain essential [long-chain] fatty acids and medium-chain triglycerides; commercial preparations often contain lipids from different sources like soyabean oil, medium-chain triglycerides, olive oil, and fish oil. Weekly at least 1 ml/kg of essential fatty acids should be given to avoid deficiency, but the total daily dose should not exceed 1 ml/kg to avoid liver complications[32,34]. Daily fluid volume is 25-35 ml/kg and should be adjusted according to the patient's intake and output[30].

Recommendation 1.9.2: electrolyte and fluid supplementation in PN

A summary of daily requirements of fluids and electrolytes is given in Table 2.

Table 2. Recommendations for fluid and electrolyte supplementation with parenteral nutrition[35]

	/kg/day
Water	25-35 ml
Sodium	1-1.5 mmol
Potassium	1-1.5 mmol
Chloride	1-1.5 mmol
Phosphate	0.3-0.5 mmol
Magnesium	0.1-0.15 mmol (1g Mgso4 = 4 mmol)
Calcium	0.1-0.15 mmol (10 ml calcium gluconate = 2.33 mmol)

Recommendation 1.9.3: Monitoring in patients on PN

The patients on PN need frequent monitoring during the initial phase; the frequency can be decreased as the patient stabilizes and losses decrease. The recommended parameters and their frequency of monitoring are mentioned in Table 3.

Table 3. Recommendation for monitoring patients on PN

Parameter	Initial frequency	After stabilization
Weight	Daily	2-3/week
CBC, PT-INR, TG, LFT	1-2/week	Monthly
Electrolytes	Daily	1-2/week
Mg, Ca, Ph	Daily	1-2/week
Capillary glucose	3-4/day (until <150mg/dl consistently)	

Enterocutaneous fistula

Enterocutaneous fistula (ECF) is an abnormal communication between the gut and the skin[36–39]. It is usually caused by trauma and iatrogenic mishaps. It can also result spontaneously from Crohn's disease, radiation enteritis[39,40], or diverticular disease[41]. ECF leads to malnutrition and fluid and electrolyte disturbances[37,42,43]. These problems are profound when the fistula is high output and if sepsis aggravates the condition.[37,44–49]. Prompt fluid management with aggressive nutrition will ameliorate the deleterious side effects of ECF[40,44].

A multidisciplinary team of doctors, dietitians, and stoma care nurses is involved in ECF management[36]. The latter manages the effluent collection and skin care around ECF.

Recommendation 2.1: Nutritional status assessment for ECF patients

- **Diet chart should be prepared after formal assessment of the needs and losses.**
- **Nitrogen balance calculation gives appropriate idea of the anabolic status and nutritional needs of the patients.**

The nutritional status assessment involves compilation of anthropometric composition, clinical and biochemical parameters. It is a dynamic process involving calculating protein-energy requirements, formulating a diet chart, checking its tolerance according to the route of administration, and modifying it to meet requirements with patient comfort[44].

Nitrogen balance ([NB) is a measure of anabolic status. It helps in monitoring whether the nutrition given meets requirements. If this turns out to be negative, then diet modification is necessary. Unlike any other patients, ECF patients need correction while calculating nitrogen balance. An additional 1 g of nitrogen loss should be added for every 500 ml fistula output[50]. The modified ECF (NB) equation is:

NB = (Protein intake (g) ÷ 6.25) — Urinary Urea Nitrogen (UUN) + 4 g + (2 g × liters of abdominal fluid loss) + (2 g × liters of fistula effluent).[48]

Recommendation 2.2: Routes of feeding in ECF patients

- **Enteral nutrition is preferred if sufficient length of functional intestine is present.**
- **Parenteral nutrition should supplement or replace enteral nutrition when nutritional demands are not met with the latter alone.**
- **Electrolyte and glycaemic monitoring is mandatory at regular intervals while administering parenteral nutrition.**

Access to feed in ECF patients depends on the available length of the bowel available distally, the presence of intra-abdominal sepsis, and loss through the fistula[51,52]. Enteral Nutrition [EN] is preferred in favorable conditions as it is readily available at a low cost and has few complications. However, EN cannot be given in case of intestinal obstruction, sepsis, and very short functional bowel.[53] Low residue, easily absorbable feed is given enterally. Volume and concentration are gradually increased over a week time[40].

Early enteral nutrition in ECF fistula has been associated with earlier fistula closure[40], better anastomotic integrity, lower pneumonia rate, and a lower fistula recurrence rate[54].

Fistuloclysis uses the fistula opening to access enteral feed and to refeed gastrointestinal effluent[48]. Although it is done in very selective cases in consultation with a stoma therapist, it ensures that some nutrition is given through the intestines[55].

Parenteral feeding can be supplemented if EN alone does not fulfill nutritional requirements[56]. However, combining both routes is preferable over the total parenteral route as it helps maintain gut mucosal integrity and immune function[45].

Total parenteral nutrition (TPN) is usually given when preparing an ECF patient with intestinal obstruction for surgery and in an early postoperative phase when the gut function is recovering. High volume and hyperosmolar feeds can be given through central venous line only. Adjusting the acetate, bicarbonate, phosphate, and chloride is essential to maintain the acid-base balance[48]. Duplication of the dosage of vitamins and trace elements is recommended in high-output fistula[57].

Although TPN has the advantages of tapering fluid, electrolyte, nutrient, and vitamin needs according to the need, it has associated complications like bloodstream infections and thrombosis. TPN damages gut mucosal barrier, and sepsis results from bacterial translocation. Strict monitoring of blood glucose and electrolyte levels is mandatory while giving TPN[58,59].

Recommendation 2.3: Immunonutrition

- **Role of imunonutrition in ECF/Stoma is not established and is extrapolated from critically ill patients to maintain gut immune function.**

Role of immune nutrition in critically ill and post-surgical patients has been studied with decreased postoperative complications. Its role in ECF is still not established. Glutamine is a source of energy and nitrogen for small intestinal mucosa and immune cells like lymphocytes[60]. Several other nutrients, including arginine, omega-3 fatty acids, antioxidants, and nucleotides, have shown benefits in critically ill patients' recovery; this could be extrapolated to ECF patients for maintaining better gut mucosal integrity and immune function[61].

Nutritional management in patients with Stoma

- Colostomy has the least implication on patient's nutritional and fluid requirements.
- Small bowel stoma goes through three phases of adaptation; protein energy requirements are higher in initial phases.

Managing nutrition in a patient with stoma depends on which part of bowel is diverted.

Colostomy

A colostomy is almost similar to a normal bowel with one or two daily semisolid bowel movements with the

slightest nutrient disturbances. Oral feeds can be started once bowel movement ensues, starting from liquids and gradually progressing to a low-residue diet. Increased water and salt intake are recommended to compensate for the absence of distal colon in its absorption.[62–64]. The composition of nutrients should be 60 % carbohydrates, 20 % fat, and 20% protein, with limit of MCT of 40 g/ day[65]. Food items that can cause excessive flatulence, foul odor, and blockage are avoided, e.g., carbonated drinks, high-fat foods, raw fruits with skin, raw vegetables, whole grains, fried poultry or fish, legumes, beans, and spicy foods.

Ileostomy and jejunostomy

The most commonly performed stoma is ileostomy, with a porridge-like output of about 600- 800 ml/ day. However, they must be monitored for nutritional losses incurred in colon and distal ileum absence[62–64,66,67]. Jejunostomy is a high-output stoma with significant implications on nutrition, fluid, and electrolyte balance and is usually accompanied by features of short bowel syndrome.

Patients with ileostomy have three phases after surgery. During the first phase after the construction, fecal effluent usually increases, and available bowel function has not restored fully. Therefore, few may need PN to supplement EN. Once the effluent becomes semisolid, during the second anabolic phase, PN can be stopped gradually. In this phase, patients usually have an excess protein-energy requirement, around 40–60 Kcal/ kg energy and 1.5 g/kg protein.[68–70]. The third phase happens following intestinal adaptation, in which energy requirement is slightly higher than in normal individuals with special care to avoid diarrhea and micronutrient deficiency[71]. Without the colon, the diet should contain 30-40% fat, 40- 50% carbohydrates, and 20% protein. Oxalate-rich food like spinach and parsley is avoided to prevent renal stones.

Nutrient supplementation should be planned according to area resected. Bile acids and vitamin B12 should be given after non-availability of terminal ileum. Calcium, iron, magnesium, protein, carbohydrate, and fat are absorbed in proximal jejunum, which should be provided adequately in corresponding patients.[72,73]

General considerations for nutritional intake in stoma patients: [74]

1. Lactose intolerance is common in initial period, and dairy products can be avoided to reduce flatulence and bloating.
2. Small frequent meals at regular intervals are helpful. Skipping a meal increases gas and bloating.
3. Food should be cut into small pieces and chewed well to avoid clogging and blockage of contents.
4. Fluids can be taken in between instead of along with solids to avoid dumping.
5. Buttermilk, cranberry juice, and peppermint reduces flatus and controls odor.

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