

Carol Rees Parrish, M.S., R.D., Series Editor

Short Bowel Syndrome in Adults – Part 4A

A Guide to Front Line Drugs Used in the Treatment of Short Bowel Syndrome



Lingtak-Neander Chan



John K. DiBaise



Carol Rees Parrish

A 64-year-old woman is hospitalized with hypotension, chronic diarrhea (6-10 per day over the past 4 weeks), fatigue and general malaise. Seven weeks ago, she was hospitalized with acute abdominal pain and severe nausea. Further work-up revealed acute mesenteric infarction due to a superior mesenteric artery thrombus and she underwent extensive resection of the ischemic bowel leaving her with about 100 cm of small bowel from the ligament of Treitz anastomosed to the proximal transverse colon. She was discharged from the hospital 2 weeks later on home parenteral nutrition (PN). Her weight is down 6 kg since hospital discharge 5 weeks ago. In addition to PN, she also takes loperamide 2 mg TID as needed (she has not been using it because “it doesn’t help”), cholestyramine 4 g BID, mirtazapine 15 mg daily, levothyroxine 0.075 mg daily and oral glutamine 30 g daily. Famotidine, 40 mg, has been added to her PN. Stool output, which is watery and without blood, ranges from 2500 to 3000 mL daily. She is not eating much as she is so depressed and uncomfortable and “it just comes right out anyway”; she is afraid to leave her house for fear of “having an accident.” Part 4A & B of this 5-part series on SBS will focus on conventional pharmacological agents used in the treatment of short bowel syndrome that will allow you to help this woman control her diarrhea and improve her quality of life.

INTRODUCTION

The intestine is a vital organ for the absorption of nutrients, fluids, and drugs. In patients with short bowel syndrome (SBS), malabsorption of drugs is an important consideration, particularly if the expected clinical response to a medication is not attained. In assessing the cause of lack of clinical response, a

number of factors should be considered (Table 1).¹ The extent of a patient’s malabsorptive potential will depend on the length, location and health of the remaining bowel, the form of the medication administered and, in some cases, the site of action of the drug.² Although the proximal small bowel is the primary site of drug absorption, many drugs can be sufficiently absorbed along the entire length of small intestine. There is even strong evidence that some drugs can be efficiently absorbed in the colon.³⁻⁶ The solution in response to a lack of clinical response of a drug will vary and may include escalating the dose, changing to a different dosing schedule or frequency, and/or changing to a different drug formulation (e.g., crushed tablet, capsule,

Lingtak-Neander Chan, PharmD, BCNSP, Associate Professor of Pharmacy and Nutritional Sciences, University of Washington, Seattle, WA. John K. DiBaise, MD, Professor of Medicine, Mayo Clinic, Scottsdale, AZ. Carol Rees Parrish MS, RD, Nutrition Support Specialist, University of Virginia Health System Digestive Health Center of Excellence, Charlottesville, VA

Table 1. Factors Affecting Medication Absorption in the SBS Patient

- The change to the total surface area, permeability, and integrity of the intestinal epithelia
- The change in orocecal transit time
- The impact on dissolution and release of the drug from the formulation
- Loss of the specific absorptive area in the bowel where the medication is routinely absorbed
- Loss of specific enzymes or epithelial transport proteins needed to activate the drug
- The location of the bowel that acts as the site of action for the medication
- The health of the remaining bowel
- The magnitude of intestinal adaptation
- Other factors that alter intestinal architecture leading to impaired absorption (e.g., small intestinal bacterial overgrowth)

liquid) or route of administration (e.g., intravenous, subcutaneous, transdermal).

Understanding the Implications of Drug Formulations

Medications in solid dosage forms, such as a tablet, need to undergo disintegration and dissolution before absorption can take place. Disintegration, whereby the tablet is broken down into small particles, takes place efficiently in the stomach in the presence of gastric acid along with the help of the churning and grinding action of the distal stomach. Dissolution is the process by which the active ingredient is dissolved into a liquid medium⁷ and is the final process to allow the active ingredient to be absorbed in the small intestine. Dissolution may take place in the stomach, the duodenum or the proximal jejunum. The dissolution rate is specific to the active ingredient and is pH-dependent. Regular tablets, capsules, and caplets undergo a similar process of disintegration and dissolution. Delayed-release tablets and enteric-coated tablets are formulated with a chemical coating to delay disintegration and dissolution until the tablet has passed through the stomach to prevent the active ingredient from being destroyed or inactivated by gastric secretions or where it may irritate the gastric mucosa.⁷ Time-release formulations, such as extended-release or controlled-release tablets are formulated to make the active ingredient(s) available for absorption over an extended period of time following ingestion, especially in the small intestine.^{8,9}

Based on these principles, impaired disintegration and dissolution of a regular tablet can occur in the setting of gastric, duodenal or proximal jejunal resection

or achlorhydria, and may result in decreased oral drug absorption (i.e., bioavailability). Fortunately, SBS patients rarely have had resections of the upper gut. In these patients, improved absorption of medication can be achieved by using liquid dosage forms, such as oral solutions or suspensions (be watchful for sugar alcohols such as sorbitol and xylitol that can exacerbate diarrhea), or crushed tablets. In patients with only partial resection of the jejunum or proximal ileum, although the rate of drug absorption may be altered, the overall extent of drug absorption appears to be preserved.¹⁰⁻¹³

Drug malabsorption is more likely in patients with extensive resection of the distal jejunum and ileum, especially with the loss of the terminal ileum and ileocecal valve,^{2,12} the most common area resected in SBS patients. In these patients, if the desired clinical responses cannot be achieved by orally administered medications, use of an alternate route of drug administration such as the use of transdermal patches, subcutaneous injections or even intravenous administrations should be considered. In patients with extensive GI tract resection, sustained-release or extended-release products should generally be avoided, as the extent of drug absorption can be erratic or severely impaired.

Assessment of Drug Response

When evaluating suboptimal clinical responses to medications in SBS, a clinician should evaluate factors related to the patient and the specific medication involved. Table 2 outlines a process to aid clinicians in critically assessing the potential cause(s) of inadequate drug response.

Table 2. Assessment of Drug Response in Patients with SBS

Patient Factors	<ol style="list-style-type: none"> 1. Has the patient been taking the medications as directed? <ul style="list-style-type: none"> • Non-adherence is a major cause of lack of therapeutic response. Adherence can generally be assessed by performing a pill count, refill frequency for the prescription, and a thorough interview (with a non-punitive approach) with the patient. 2. If non-adherence is a factor, clinicians should investigate why the medication was not taken as directed. <ul style="list-style-type: none"> • The problems leading to non-adherence is not always the patient's fault. Does the patient know what the medication is used for? Were the directions given to the patient clear? Was the patient clear about what to expect from the medication? For example, if a drug takes 1 to 2 weeks to work, has the patient been informed so that he/she would not stop taking a drug after 2 doses thinking the medication is not working. 3. Has the underlying medical condition of the patient changed that could have altered the clinical response of the medication? <ul style="list-style-type: none"> • For example, does the patient have acute renal failure, which may explain why the patient's blood pressure is not controlled despite the concurrent antihypertensive medications? 4. Has the patient experienced any changes in social issues that would make him/her unable to afford medications? Or did insurance deny coverage?
Provider's Approach	<ol style="list-style-type: none"> 1. Are the dose and frequency of the medication prescribed correctly for the condition specific to the patient? 2. Are the directions for the prescription feasible for the patient? (e.g., is it feasible for this patient to take this medication 6 times a day? Is the patient comfortable with giving an IM injection?) 3. Has the medication-related information been communicated clearly to the patient? Does the patient know whom to contact for additional questions or concerns? 4. For inpatients, was a PRN order actually administered by the nursing staff? Were the criteria for PRN clearly written and communicated to other providers? 5. Are there drug-drug or drug-nutrient interactions that could have negatively affected the efficacy of the drug? 6. For a prescription drug filled by a compounding pharmacy, is the compounding pharmacy a reliable provider? Is the drug adulterated?
Medication-Related Issues	<ol style="list-style-type: none"> 1. Are the symptoms exacerbated by the excipients of the drugs (e.g., sorbitol, xylitol)? 2. Is the choice of medication rational and specific for this patient? 3. Is the regimen (dose, dosage form, frequency) optimal for this patient? 4. Is the patient experiencing an adverse event from another medication? 5. Is the clinical presentation related to an event unrelated to the underlying condition and the medication? (e.g., uncontrolled diarrhea due to undiagnosed <i>Clostridium difficile</i> infection) 6. Is the medication regimen prescribed the best choice for the condition? (e.g., using anti-motility agent alone for gastric hypersecretion) 7. Is the medication available at the patient's pharmacy?

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Management of GI Hypersecretion and Chronic Diarrhea in SBS

The most commonly used medications in the SBS patient, particularly during the period of greatest intestinal adaptation, are antisecretory and antimotility agents. They are frequently necessary to control gastric hypersecretion and chronic diarrhea. Antimotility agents will be discussed in Part 4B of this series.

Gastric Hypersecretion

The link between gastric acid hypersecretion after resection of a large segment of small intestine has been known for decades and has been attributed to the development of parietal cell hyperplasia and hypergastrinemia. This process generally lasts up to 12 months after a single massive resection with more than 50% of the small intestine removed.^{14,15} If additional resections are performed, the duration of gastric hypersecretion may be more prolonged. Hypersecretion results in an increase in fluid volume entering the small bowel contributing to diarrhea; it also lowers the pH of the proximal small intestine and may result in peptic injury and inactivation of pancreatic digestive enzymes further aggravating fat maldigestion.^{16,17} Fortunately, with the availability of potent and safe acid reducing drugs, gastric hypersecretion in most patients can be effectively managed using histamine-2 receptor blockers (H2RB) and proton pump inhibitors (PPI). Table 3 summarizes the established regimens for different antisecretory drugs and their monitoring parameters.

Histamine-2 Receptor Blockers

H2RBs are a good choice as initial empirical therapy for gastric acid hypersecretion, on-demand symptom/acid control, or for the management of breakthrough acid hypersecretion. H2RBs demonstrate a dose-dependent effect in reducing gastric acid secretion.¹⁸ They are generally safe and are the only systemic drugs with an immediate onset of action in reducing gastric acid secretion. Clinical effect can be detected within 1 hour after drug administration.^{19,20} These drugs are available as oral and intravenous formulations. The intravenous formulations are also compatible with most parenteral nutrition (PN) solutions, making them a very accommodating therapeutic option for patients as initial therapy after intestinal surgery. Nevertheless,

the long-term effectiveness of H2RBs is limited by their relatively modest efficacy and the development of tolerance over time despite dose-escalation.

Proton Pump Inhibitors

PPIs are the most potent agents in the management of diseases requiring the reduction of gastric acid secretion and are the primary drugs used as maintenance therapy for gastric hypersecretion. PPIs are most effective when proton pumps are active, such as during meal time under normal physiology. Therefore, the best time to administer these drugs is shortly before meal time.^{21,22} Maximal inhibition of acid secretion will require at least 3 to 5 days of continued therapy.^{23,24} In patients with SBS, especially those receiving nutrients exclusively by PN, it is less clear how to maximize the efficacy of PPIs. Additionally, up to 30% of the patients may not show adequate clinical response to PPIs.^{25,26} Poor response may be due to altered pharmacogenetics, non-adherence to therapy, and/or other physiological causes.²⁶⁻²⁸ Therefore, PPIs may not be the best therapeutic agent for all patients.

All oral PPI products are formulated with an enteric-coating (either on the outer shell of the tablet or the cover of the granules inside the capsule) to protect the drugs from acid-mediated deactivation. Some products have additional extended-release characteristics in order to extend the duration of time the active drug is present in the body. Because PPIs are absorbed in the small intestine,²⁴ in patients with SBS, their oral bioavailability may be limited. It is unclear whether the drug is absorbed adequately in the colon. In general, the clinical efficacy of the different commercially available PPIs is considered comparable.

If there is a lack of clinical response to antisecretory therapy with an oral PPI in the early postoperative period, it is reasonable to consider a trial of IV PPI as oral drug absorption may be compromised immediately after resection of small intestine. Limited data suggest that IV PPI should be started with either a twice daily bolus regimen or as a continuous infusion. A patient can be characterized as having a positive response if clinical symptoms improve (significant decrease in stool/ostomy volume) within 5 days of the initiation of IV PPI.

With proper monitoring, PPIs are safe and effective and should be considered an integral treatment for gastric hypersecretion. In the SBS patient, a PPI should

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Acid Reducing Agents	Dose/Form/Frequency
Histamine2-receptor Antagonists (H2 Blockers)	
Pepcid® (famotidine)	20-40 mg Q12H PO or IV
Zantac® (ranitidine)	50 mg IV Q8H or 150mg PO BID
Tagamet® (cimetidine)	300 mg Q6H PO or IV
Axid® (nizatidine)	150 mg Q12H PO
Proton Pump Inhibitors (PPIs)	
Nexium® (esomeprazole)	20-40 mg daily or BID, increase up to 240 mg/day Available as oral capsule, single dose granular packet for oral suspension, and IV
Prilosec® (omeprazole)	20 mg QD PO, titrate up; max dose 120 mg TID
Zegerid® (omeprazole and sodium bicarbonate)	20-40 mg QD PO Available as oral capsule or powder for oral suspension. Each 20 and 40 mg capsule contains 1100 mg of sodium bicarbonate, whereas each 20mg and 40mg powder packet contains 1680 mg of sodium bicarbonate
Prevacid®, Prevacid SoluTab® (lansoprazole)	Suspension available (has sorbitol) Start at 60 mg QD, max 90 mg BID
Protonix® (pantoprazole)	IV, capsule (delayed release) Start at 40 mg BID, max 240 mg/day
Dexilant® (dexlansoprazole)	30-60 mg QD, max dose likely similar to lansoprazole
AcipHex® (rabeprazole)	20-60 mg QD, max 120 mg/day
Other Agents	
Octreotide (a somatostatin analog)	SQ or IV 50–500mcg to TID-QID (subcutaneously)
Clonidine	Starting dose 0.05-0.1 mg BID, typical range 0.1 to 0.4mg/d

Comments

Dose adjustment is necessary for decreased renal function for all H2RBs

- Sustained-release [SR] (extended-release [ER, XR, XL], controlled-release [CR]) capsules may be lost in liquid stool or ostomy effluent before the content was completely released in a shortened bowel
- May need every 8 hour dosing
- Try IV to see if clinical efficacy improves
- Consider trial of IV PPI BID or continuous infusion if clinical response is in question due to absorption concerns
- Note that the SoluTab is NOT a sublingual tablet. It is an orally-disintegrating tablet absorbed in the small intestine
- Orally disintegrating tablets and powder are also available for some products for administration in patients with dysphagia or a feeding tube

- Use of octreotide is limited due to high cost, inconvenience and discomfort of SQ injections, risk of cholelithiasis
- Can reduce intestinal adaptation
- Gall stones have been reported in some individuals possibly due to the decrease in gall-bladder contractility
- Stinging at injection site can be lessened by warming the drug before injection
- For IV injection, to decrease pain at the site of injection, warm the drug before injection and give slowly over 3 to 5 minutes or diluted in 50 to 200 mL of NS or D5W and infusion over 15 to 30 minutes
- Octreotide can also be added to PN solutions, although the dose may need to be increased due to adsorption to tubing
- The average cost of octreotide therapy with supplies may run between \$1,200 - 2,000 a month at a dose of 100 mcg TID, depending on the health plan

- Should be used only in those with secretory diarrhea refractory to opiate anti-diarrheals
- Dangerous hypotension may result, especially in patients with dehydration
- For oral doses, clonidine should be start at 0.05 mg twice daily and titrate up every 2 to 3 days as tolerated. Once clinical response is observed, the oral dose can be converted to the transdermal patch (i.e., in a patient receiving 0.1 mg twice daily, the dose can be converted to clonidine patch 0.2 mg/day)
- The transdermal patch is to be replaced once a week
- If the transdermal patch is to be used to initiate therapy, the dose should be started at 0.1 mg/day
 - Patients should be advised to remove the transdermal patch before undergoing a magnetic resonance imaging procedure as burn injuries have been reported ^{34, 35}

Table 4. Potential Adverse Reactions Associated with Antisecretory Drugs

Drug/ Drug class	Common Adverse Drug Event	Monitoring
H2RB	delirium, hallucination, drowsiness, thrombocytopenia	renal function, neurological status (especially in older adults), platelet counts in critically ill patients
Proton pump inhibitors	hypomagnesemia, hypocobalaminemia, small intestinal bacterial overgrowth, increased risk for community-acquired pneumonia, and increase risk for GI tract infection by <i>Clostridium difficile</i> species	magnesium, calcium, signs of GI or respiratory tract infections
Octreotide	hyperglycemia, hypoglycemia, bradycardia (heart rate < 50 beats per minutes), cholelithiasis, hypothyroidism, hypocobalaminemia, and abdominal discomfort	blood glucose, heart rate
Clonidine	hypotension, contact dermatitis, erythema, pruritus, xerostomia, headache, somnolence and fatigue	blood pressure, fluid status, skin reactions

be started as soon as possible after small intestinal surgery and can generally be initiated orally for most patients. For all PPIs, it will take about one week for a clinically significant response to be seen. Since H2RBs provide a more immediate clinical response, it is not unreasonable to have concurrent treatment with a PPI and an H2RB during the initial treatment period.

Clonidine

Clonidine is a centrally acting α_2 -adrenergic receptor agonist approved by the Food and Drug Administration for the treatment of hypertension. The GI-related side effects of clonidine include dry mouth and constipation. The exact mechanism of clonidine in reducing gastric hypersecretion is unclear, although clonidine has been shown to reduce diarrhea in patients with proximal jejunostomy and those with diabetic diarrhea. Clonidine decreases fecal water and sodium losses and prolongs intestinal transit time in patients with chronic diarrhea.²⁹⁻³³ As an antisecretory drug, clonidine can be administered orally as a tablet or as a transdermal patch, a potentially advantageous option for the patient with SBS where there may be unreliable oral absorption. The effective doses are between 0.1 to 0.4 mg per day.^{29,30,32} The patch only needs to be replaced weekly.³⁴ One of the most serious side effects of clonidine is hypotension, which may be exacerbated by dehydration from chronic diarrhea, seriously limiting its use in SBS. Therefore, the dose of clonidine should be started cautiously and slowly titrated up. Patients should also be advised to

remove the transdermal patch before undergoing a magnetic resonance imaging procedure as burn injuries have been reported.^{34,35}

Octreotide

Octreotide is a synthetic analog of somatostatin. Somatostatin decreases endocrine and exocrine secretion and blood flow, reduces gallbladder contraction, slows down GI motility and inhibits secretion of most GI hormones. Inhibition of gastrin release is likely the primary mechanism for octreotide's benefit in the treatment of gastric hypersecretion. Octreotide is available in only two parenteral forms – octreotide acetate injectable solution, which is intended for intravenous or subcutaneous injection; and octreotide acetate injectable suspension (or LAR depot), which should only be administered as an intramuscular injection. Octreotide solution is physically compatible with most PN solutions providing additional flexibility for drug administration. When starting octreotide therapy, the injectable solution should be initiated first to allow dose titration and determination of the optimal dose based upon the clinical response. Once efficacy is established, the regimen can be converted to the injectable suspension to allow less frequent dosing. Although the use of octreotide in various types of diarrhea has been reported, its effectiveness in reducing gastric hypersecretion is highly variable and unpredictable.³⁶

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The typical starting dose for octreotide is 50 or 100 mcg subcutaneously TID. The dose can be titrated up every 3 to 4 days based upon clinical response; most patients will require a total daily dose between 200 to 300 mcg to attain a clinical response.^{37,38} Octreotide is not the primary therapeutic agent for acute control of GI hypersecretion given its cost, subcutaneous administration, and since it generally takes 5 to 7 days to see a clinically significant response. Importantly, in SBS, since octreotide inhibits the release and function of most GI hormones, it can negatively affect intestinal adaptation. See Table 3 for a summary of the antisecretory agents and Table 4 for potential adverse reactions.

Other Pharmacotherapies Sometimes Considered in the Treatment of SBS

Bile Acid Binders

Resection of > 100 cm of terminal ileum affects the reabsorption of bile acids into the enterohepatic circulation, hence, reducing bile acid production. Since 95% of bile salts are recirculated, the reduced bile acid absorption eventually exceeds the ability of the liver to synthesize adequate replacement. This decreased bile

acid pool results in impaired micelle formation and fat digestion, and manifests clinically as steatorrhea and fat soluble vitamin deficiencies. As such, the use of bile acid sequestrants may actually worsen steatorrhea and fat-soluble vitamin losses in the SBS patient and should generally be avoided, or at most reserved for those with a colon who fail other front line agents.³⁹ The entry of bile acids into the colon also enhances water secretion and accelerated colonic motility (due to the caustic nature of bile salts on colonic mucosa), affecting the colonocytes ability to reabsorb salt and water. Although an attempt to improve the depleted bile acid pool using bile acid supplements would seem worthwhile in order to improve fat maldigestion, there are no suitable bile acids readily available that will not also aggravate stool losses. See Table 5 for the doses and monitoring parameters of different bile acid sequestrants.

Pancreatic Enzymes

SBS patients with extensive proximal small bowel resections may lose sites of secretin and cholecystokinin-pancreozymin synthesis and develop decreased pancreatic and biliary secretions,⁴⁰ fortunately, most SBS

Table 5. Commercially Available Bile Acid Sequestrants

Bile Acid Binder	Dose	Comments
Powder		
Cholestyramine Questran®, Questran® Light, Prevalite®, LoCHOLEST®, LoCHOLEST® Light	4 grams mixed in water or other fluids 1-6 times/day	<ul style="list-style-type: none"> • NOT for use in patients with end jejunostomy or ileostomy (i.e. those without a colon). • Best used in those with <100 cm ileum resected (or if quality of ileum is in question). • May be most beneficial when used with first meal of the day and at night.
Colestipol Colestid®	5-gram packet 1-6 times/day	<ul style="list-style-type: none"> • Bile acid resins can bind Imodium and some nonsteroidal anti-inflammatory agents reducing their activity. • May worsen steatorrhea/fat-soluble vitamin deficiencies if >100 cm ileum resected due to an aggravation of existing bile acid deficiency. • Poor taste/grittiness may affect adherence. • May interfere with the absorption of some medications (warfarin, diuretics, thyroid hormone, beta-blockers, digoxin) and fat-soluble vitamins; medications should be taken 1-hour before or 4-hours after bile acid sequestrant administration.
Tablet/ Suspension		
Colesevelam WelChol®	1.25-3.75 g/day	<ul style="list-style-type: none"> • Does not decrease the absorption of co-administered medications

patients have extensive distal small bowel resections and demonstrate normal pancreatic enzyme and bilirubin secretion. Pancreatic function is reduced in patients on PN only when there is no concomitant enteral/oral diet and, potentially, during the hypersecretory period if no antisecretory medications are being used. Although there may be concern about a mismatch of the timing of the mixing of ingested nutrients with pancreatic enzymes due to the alterations in anatomy and small bowel transit, evidence supporting the usefulness of pancreatic enzyme supplementation in SBS is lacking (and they add yet even more to that “total pill count”).

Antimicrobials

Small intestinal bacterial overgrowth (SIBO) is common in SBS patients.⁴¹ The combination of bowel dilatation and altered transit frequently seen in SBS, together with medications commonly used in these patients (e.g., acid suppressants and antimotility agents) is thought to facilitate the development of SIBO. Excess bacteria in the small bowel can:

- Induce inflammatory and atrophic changes in the gut impairing absorption
- Deconjugate bile acids resulting in fat maldigestion
- Consume vitamin B12 leading to deficiency
- Cause a number of gas-related symptoms
- Aggravate diarrhea leading to a reduction in oral intake

A number of limitations of the tests used to diagnose SIBO (i.e., small bowel aspirate with quantitative bacterial culture and hydrogen breath testing most commonly used), make securing the diagnosis of SIBO in SBS challenging. Because of the test limitations and the increased risk of SIBO in this patient population, empiric treatment is often provided. Antimicrobial treatment is generally prescribed; a variety of oral broad-spectrum antibiotics can be used (Table 6) with success being judged on improvement in symptoms, reduction in stool output and/or weight gain. The continuous use of low-dose antibiotics in SBS may be necessary in some patients. To reduce the risk of antibiotic resistance, periodic rotation of 3 or 4 antibiotics is advised.

Probiotics

While high-quality evidence supporting the use of prebiotic, probiotic and synbiotic agents in SIBO is lacking in adults, there is emerging evidence from both preclinical studies and reports in the pediatric SBS population of their benefit.⁴² It is also important to remember that probiotics are regulated as dietary supplements in the U.S. and therefore product purity and safety cannot be guaranteed. Until clear evidence is available, probiotic use cannot be recommended at this time.

Glutamine

Glutamine, a ‘conditionally essential’ amino acid, is a primary energy source for the enterocyte. Its use in SBS was popularized by a series of retrospective, open-label studies and a prospective randomized,

Table 6. Examples of Antibiotic Options to Treat SBBO

Agent	Dose = 7-14 days
Amoxicillin-clavulanate	500 mg PO 2-3 times/day
Cephalexin	250 mg PO 2 times/day
Ciprofloxacin	500 mg PO 2 times/day
Doxycycline	100 mg PO 2 times/day
Metronidazole	250 mg PO 3 times/day
Neomycin	500 mg PO 2 times/day
Norfloxacin	400 mg PO 2 times/day
Rifaximin	550 mg PO 2-3 times/day
Tetracycline	250-500mg PO 4 times/day
Trimethoprim-sulfamethoxazole	1 double-strength tablet PO 2 times/day

controlled clinical trial when used in combination with human growth hormone and an optimized diet.^{43,44} Nevertheless, when glutamine alone was added to an ORS provided to adult SBS patients with an end-jejunosomy, no benefit was seen in terms of fluid or sodium absorption.⁴⁵ Furthermore, in a randomized, controlled, crossover study involving eight adult SBS patients, glutamine resulted in no difference in small bowel morphology, transit time, D-xylose absorption or stool output.⁴⁶

SUMMARY

Treatment of short bowel syndrome requires aggressive use of several different pharmacological agents. To maximize their efficacy, it is important for clinicians to give thought to the site of absorption, formulation, frequency, timing of each drug and individual patient's response to therapy. Setting and monitoring endpoints for each intervention (i.e., how long you will give each intervention time to achieve efficacy or not), is crucial in the care of the SBS population. In addition, cost considerations and availability to the patient depending on where they obtain their medications are important in order to improve medication adherence. Finally, remember that there are only 24 hours in a day, one-third or more of which is spent sleeping. It is important to periodically do a "Total Pill Count," as not only do the prescription medications, over-the-counter medications, and vitamin/mineral supplements add up (and can be quite overwhelming), the osmotic contributions of these agents, as well as the sheer volume of fluid needed to take them, can contribute to yet even more stool or ostomy output. ■

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