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All attendees will be muted and will remain in "Listen Only Mode"

Type your questions here so that the moderator can see them.
Not all questions will be answered but we will get to as many as possible.

A handout with the slides and room to take notes can be downloaded from your control panel.

Moderator:
Dejan Micic, MD, FACG

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5

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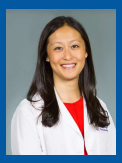
ACG Virtual Grand Rounds

Join us for upcoming Virtual Grand Rounds!



Week 36 – Thursday September 4, 2025
Patients Needs and Satisfaction in the IBD Transition to Adult Care
Faculty: Ms. Sneha Dave and Ms. Rosa Kelekian
Moderator: Sunanda V. Kane, MD, MSPH, MACG
At Noon and 8pm Eastern

Week 37 – Thursday September 11, 2025
Update in UC and the New ACG Guidelines
Faculty: David T. Rubin, MD, FACG
Moderator: Shannon Chang, MD, FACG
At Noon and 8pm Eastern

Visit **gi.org/ACGVGR** to Register

6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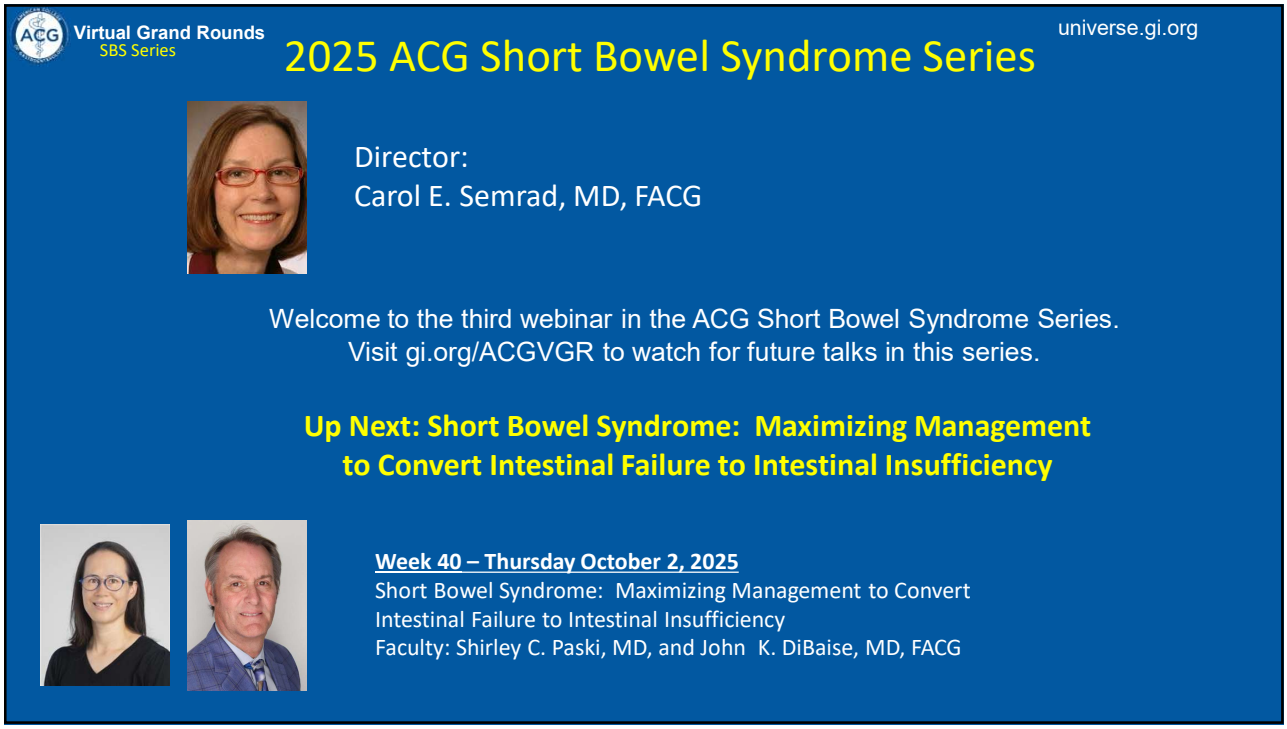
7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Virtual Grand Rounds
SBS Series
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2025 ACG Short Bowel Syndrome Series
Director:
Carol E. Semrad, MD, FACG
Welcome to the third webinar in the ACG Short Bowel Syndrome Series.
Visit gi.org/ACGVGR to watch for future talks in this series.
Up Next: Short Bowel Syndrome: Maximizing Management
to Convert Intestinal Failure to Intestinal Insufficiency
Week 40 – Thursday October 2, 2025
Short Bowel Syndrome: Maximizing Management to Convert
Intestinal Failure to Intestinal Insufficiency
Faculty: Shirley C. Paski, MD, and John K. DiBaise, MD, FACG

8

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Up Coming 2025-26 ACG SBS Series

- Small Bowel Nutrient and Fluid Absorption: Key Concepts to Manage Short Bowel Syndrome
- Inpatient Management of the Newly Diagnosed Short Bowel Patient: Consult to Discharge
- Short Bowel Syndrome/Intestinal Failure: Recognition, Complications, and Basic Management
- Short Bowel Syndrome: Maximizing Management to Convert Intestinal Failure to Intestinal Insufficiency
- Cases of Non-Short Bowel/Intestinal Failure: Pearls for Recognition and Management

9

9

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GI Nutrition Series

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Disclosures

John K. DiBaise, MD, FACG:
Immunic Therapeutics: Consultant; Napo Pharmaceuticals: Advisory Committee/ Board Member; Northsea Therapeutics: Grant/Research Support; Takeda Pharmaceuticals: Advisory board; Zealand Pharmaceuticals: Grant/Research Support

Dejan Micic, MD, FACG:
Ironwood Pharmaceuticals: Advisory Committee/Board Member; Takeda Pharmaceuticals: Advisory Committee/Board Member, Speakers bureau

**All of the relevant financial relationships listed for these individuals have been mitigated*

10

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2025 ACG Webinar Series
August 28, 2025

Short Bowel Syndrome/Intestinal Failure: Recognition, Complications, and Basic Management

John K. DiBaise, MD, FACG
Professor of Medicine
Division of GI/Hepatology
Mayo Clinic Arizona
dibaise.john@mayo.edu

11

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Learning Objectives

- Define and differentiate between SBS and intestinal failure
- Understand the importance of the remaining bowel anatomy and physiology in the management of SBS
- Describe complications associated with SBS
- Discuss the basic components of SBS management including the benefits of multidisciplinary involvement
- Impart the importance of lifelong monitoring

12

Case Scenario

- A 41-year-old man with fistulizing Crohn's disease presents to clinic.
- Complaining of high ostomy output, episodic abdominal cramping, fatigue, weight loss, and failure to thrive.
- He has undergone 4 bowel resections over the years, the last being 5 months ago, when the ostomy was created.
- **He appears to have about 70 cm of jejunum ending in a stoma. He also has about one-third or so of his left colon remaining – but not in continuity.**

- Since the most recent surgery, he has been having at least 2.5 L ostomy output daily (with frustrating leakage and skin irritation), intermittent epigastric burning, and 12 kg weight loss.
- He also describes constant fatigue, lack of energy, and being thirsty all the time (he drinks a lot of water and Gatorade). The last time he checked his urine output it was 700 mL/24 hr.

Case Scenario

Physical Exam:

- Cachectic
- Appears older than stated age
- Dry mucus membranes
- Poor skin turgor
- Abdomen is notable for a well-healed scar with a healthy appearing stoma, but the surrounding skin appears erythematous with excoriations present

Weight = 50 kg
Height = 170 cm

BMI = 17.3

Case Scenario

Lab	Value
Hemoglobin	12.9 g/dL
Hematocrit	39%
Ferritin	33 mcg/L
Magnesium	1.1 mg/dL
Potassium	3.2 mmol/L
Calcium	7.9 mg/dL
Folate	7.1 ng/mL
Zinc	89 mcg/dL
Copper	123 mcg/dL
Selenium	95 mcg/dL
Vitamin B_{12}	133 ng/mL
Vitamin A	67 mcg/dL
Vitamin D, 25-Hydroxy	45 ng/mL
Vitamin E, alpha tocopherol	11.4 mg/L
Albumin	3.1 g/dL
CRP	2.5 mg/L
Creatinine	1.72 mg/dL

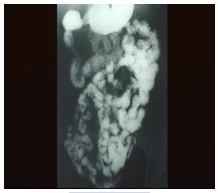
- Stool GIPP and calprotectin negative
- Jejunoscopy and CT scan unremarkable

- Infliximab every 8 weeks
- No other meds because "nothing has helped"
- He has tried oral nutritional supplements – but they made the output worse

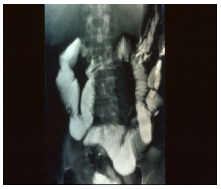
Short Bowel Syndrome (SBS) Definition

A rare disorder resulting from the loss of bowel length/mass

The primary consequences are malabsorption, malnutrition, and dehydration



Normal



SBS

Less than 200 cm of residual small bowel in continuity, with or without the colon

"Functional SBS" in patients with residual small bowel > 200 cm

The primary cause of chronic intestinal failure (CIF)

Pironi L. *Nutr Clin Pract*. 2023;38(Suppl 1):S9-S16.

Intestinal Failure (IF)

Intestinal Failure (IF):
Reduction of gut function that is persistently insufficient for macronutrient absorption, and water and electrolyte management

- Type 1: Acute
- Type 2: Prolonged
  PN required over weeks or months
- Type 3: Chronic
  PN required for months or years

SBS is **not** synonymous with IF

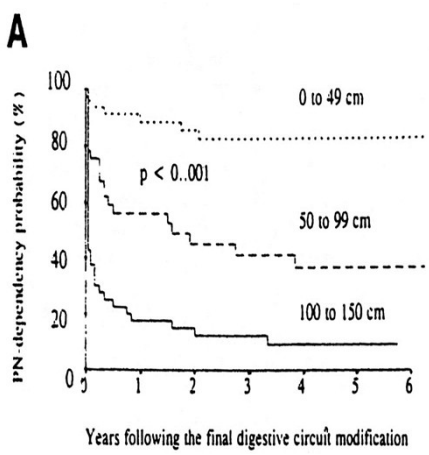
Intestinal Insufficiency:
Temporary reliance on PN/IVF
or
never required PN/IVF

Goal: convert intestinal failure to a state of intestinal insufficiency/deficiency

Pironi L. et al. *Clin Nutr*. 2023;42(10):1940-2021.

Risk Factors of Permanent IF in SBS

- Remnant bowel length
  - <100 cm end-jejunostomy
  - <65 cm jejunocolic anastomosis
  - <30 cm jejunoileocolic anastomosis
- Residual disease in remnant bowel
- Absence of colon
- Degree to which adaptation has occurred
- Time on PN
- Nutritional status



Messing et al. *Gastroenterology* 1999; Jeppesen PB et al. *Best Pract Res Clin Gastroenterol* 2003

SBS Etiology and Prevalence

PRIMARY CAUSES

Children
- Congenital anomalies
- Midgut Volvulus
- Gastroschisis
- Congenital Atresia
- Aganglionosis
- Necrotizing Enterocolitis

Adults
- Crohn's Disease
- Mesenteric Ischemia
- Post-operative Complications
- Radiation Enteritis
- Trauma

- Surgical resection
- Congenital defect
- Disease-associated loss of absorption

True incidence unknown because of:
- Reporting differences
- Main source of data likely does not capture all SBS patients

Prevalence estimated to be between 10,000 – 20,000 children and adults in the United States

Occurs in approximately 15% of adults who have undergone bowel resection
- 75% result from single massive resection, 25% multiple resections

Pironi L. *Nutr Clin Pract*. 2023;38(Suppl 1):S9-S16; Thompson JS. J Gastrointest Surg 2000; Howard L, et al. Gastroenterology. 1995;109:355-365; Mundi M, et al. JPEN J Parenter Enteral Nutr. 2017;41:535-549; Mundi M, et al. JPEN J Parenter Enteral Nutr 2022;46:1614-1622.

19

Epidemiology of SBS

- International (65 centers/22 countries) survey of 1,880 adults with SBS-IF
  - Women (60%) > men; most >50 yrs of age (69%); most normal BMI (62%)
  - Mesenteric ischemia (MI) and Crohn's disease - most common underlying diseases
    - Crohn's most common etiology in UK, US, and Denmark; MI more common in France, Italy, and Poland
  - SBS-J represented 75% of cases in UK and Denmark and 50%-60% in other countries except Poland, where SBS-JC more common
    - Crohn's: SBS-J 2x more frequent than SBS-JC and 3x more frequent than SBS-JIC
    - Mesenteric ischemia: SBS-JC and SBS-JIC more common
  - Duration of parenteral support <3 yrs in about 50%, >10 yrs in about 15%
  - About 75% received infusions ≥5 days/wk; PN in 90%

Pironi L, et al. *Clin Nutr ESPEN.* 2021;45:433-441.

20

SBS Survival and PN Dependency

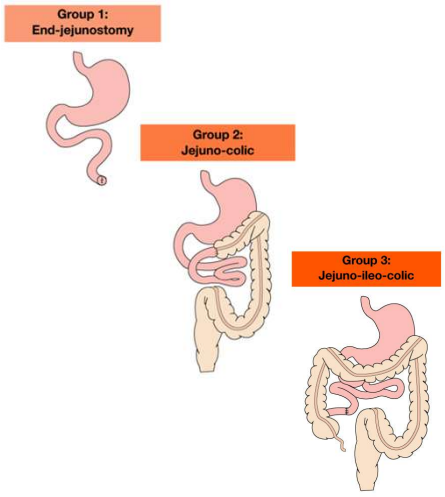
- ~70% of those with newly acquired SBS are eventually able to be **discharged from hospital**
- US and France reports demonstrate 2-year, 5-year, and 10-year **survival rates** of 80%+, 70%, and 50%, respectively
  - Survival better when <60 yrs of age; less likely when mesenteric infarction, ostomy
- French study reported **PN-dependency** in nonmalignant SBS at 1, 2, and 5 years was 74%, 64%, and 48%, respectively
  - PN dependency reduced when remaining colon >57%, and small bowel remnant length >75 cm
- More recent UK study: 6.8-fold higher **mortality** than general population
  - 17-yr shorter life expectancy; those on HPN had increased likelihood of death

Amiot A, et al. *Clin Nutr*. 2013;32:368-374; Scolapio JS. *JPEN J Parenter Enteral Nutr*. 1999;23:309-312; Messing B, et al. *Gastroenterology*. 1995;108:1005-1010.

21

Stratification of SBS Patients

Classification of SBS	Category	Criteria
	Anatomic	Length of the remnant small bowel: • ≤ 200 cm (SBS) • > 200 cm (functional SBS) Anatomy of the remnant bowel: • End-jejunostomy/ileostomy (SBS Type 1) • Jejuno-colonic anastomosis (SBS Type 2) • Jejuno-ileal-colonic anastomosis (SBS Type 3)
	Pathophysiologic	Without colon (in continuity) With colon (in continuity; remnant colon < 50% or > 50%)
	Evolutional Postoperative Phase	Early/ Intermediate Postoperative Period Rehabilitative/ Adaptive Maintenance/ Stabilization
	Clinical	Type of nutrition supplementation required to maintain nutrition status: • Oral/ enteral, intramuscular: intestinal insufficient/ deficiency • PN: intestinal failure
	Severity of CIF	Type and volume of PN required



Pironi L. *Nutr Clin Pract*. 2023;38(Suppl 1):S9-S16.

22

22

Importance of Knowing the Remaining Bowel Anatomy

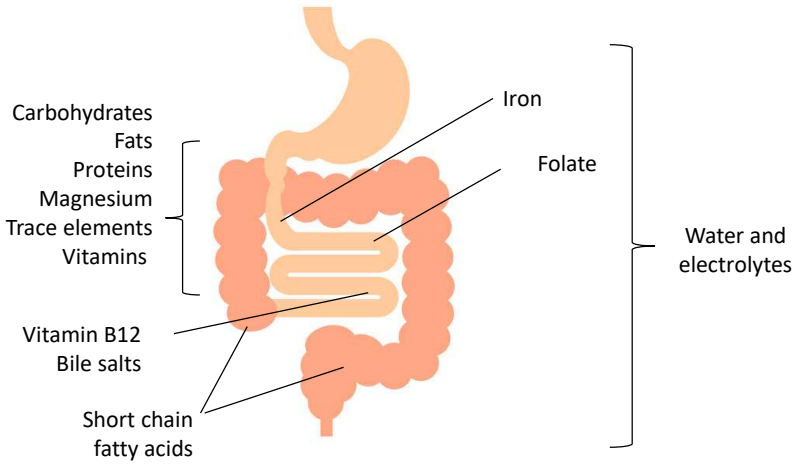
- When evaluating a patient with SBS
  - Define the anatomy of the residual GI tract with specific reference to the length of remnant small bowel, measured beyond the duodeno-jejunal flexure
  - Define whether the colon is in continuity
  - Define whether the ileo-cecal valve is present
  - Define whether the bowel ends in a stoma

- Better define prognosis
- Identify potential complication risk
- Determine best treatment

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20:2185-2194.

23

Sites of Nutrient and Fluid Absorption



Buchman AL, et al. *Gastroenterology*. 2003;124:1111-1134.

24

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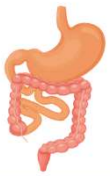
SBS Bowel Anatomy Types

Group 1: End-jejunostomy	Group 2: Jejuno-colic	Group 3: Jejuno-ileo-colic
		
• High ostomy output due to accelerated gastric and intestinal transit • Risk for dehydration, electrolyte disturbances, hypotension, and renal failure • Most challenging to manage, often require long-term PN • **SB length < 100 cm**	• Manifestations depend on the length of the jejunum and colon remaining • Weight loss, diarrhea, steatorrhea, and micronutrient deficiencies • **SB length < 65 cm**	• Best prognosis, least common • Malnutrition is rare, does not usually require long-term PN • **SB length < 30 cm**

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20:2185-2194.

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Intestinal Adaptation

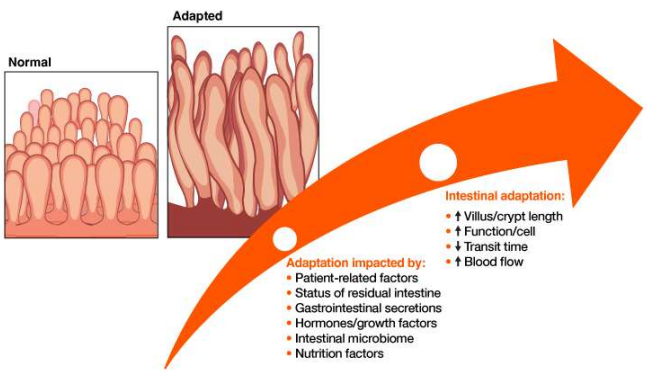
Evolution of SBS: Immediate Postoperative Period 3-6 weeks → Adaptive Period 6 weeks -2 years → Maintenance Period

Structural changes: Villous hypertrophy, increased colonic crypt depth, faster proliferation of epithelial crypts, increased intestinal length and diameter

Functional changes: Increased GI hormone secretion, reduced motility, microbiome alterations

The **ileum** has a greater ability to adapt than the jejunum
- Patients with an ileal remnant tend to have better prognosis

The **jejunum** adapts with only functional changes
- Least adaptation is seen in patients with end-jejunostomy anastomosis



Dreuille B, et al. *Med Sci (Paris).* 2021;37(8-9):742-751; Tappenden KA. *Nutr Clin Pract*. 2023;38(Suppl 1):S27-S34.

26

26

Complications in SBS

- An important priority of care in SBS is the prevention and treatment of complications
  - Related to SBS
  - Related to PN and central venous catheter (CVC)
  - Related to the underlying disease

These are often inter-related

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20:2185-2194.

27

SBS Burden of Disease

Symptoms and Complications

-Diarrhea
-Dehydration
-Electrolyte deficiencies
-Acute and chronic kidney injury/disease
-Malabsorption
-Malnutrition
-Intestinal failure
-Metabolic bone disease
-Gallstones
-Kidney stones
-Liver disease
-SIBO
-D-lactic acidosis

Impact on Quality of Life

-Degree of dependence on PN
-Flexibility or rigidity
of PN infusion schedule
-Presence of chronic abdominal pain
-Severity of diarrhea
-Ostomy output issues
-Infections
-Recurrent hospitalizations
-Depression
-Ability to continue employment
-Financial burden

Most common concerns
Diarrhea, stoma/appliance concerns, weight loss, dehydration

Bering J, DiBaise JK. *Nutr Clin Pract*. 2023;38(Suppl 1):S46-S58; Winkler M, Tappenden KA. *Nutr Clin Pract*. 2023;38(Suppl 1):S17-S26.

28

28

Common SBS-Related Complications

Key Symptoms and Complications	Potential Causes/Risk Factors	Potential Treatments
Protein Calorie Malnutrition Dehydration Micronutrient Deficiencies	Limited absorptive capacity	• Micronutrient and electrolyte monitoring/supplementation • Optimize oral diet/fluids • Optimize pharmacotherapies • Parenteral support • Intestinotrophic factor
Chronic Diarrhea	Reduced absorptive surface area Altered enterohormone feedback mechanisms Altered enterohepatic circulation Gastric hypersecretion Active bowel disease (eg, Crohn's) *C. difficile* infection SIBO	• Dietary/oral fluid modifications • Oral rehydration solution • Antidiarrheal agents • Antisecretory agents (PPI, H2RA) • Somatostatin analogs • Intestinotrophic factor (GLP-2)
Kidney Disease Nephrolithiasis Oxalosis Acute kidney injury Chronic kidney injury	Increased presence of calcium oxalate and uric acid renal stones Patients with fat malabsorption with colon-in-continuity at highest risk for oxalate stones Acute and chronic dehydration	• Maintain adequate urine output with increased fluid intake (UOP > 1 L/day, urinary sodium concentration > 20mEq/L) • Low fat/oxalate diet • Potassium citrate • Calcium carbonate

Bering J, DiBaise JK. *Nutr Clin Pract*. 2023;38(Suppl 1):S46-S58.

29

29

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Common SBS-Related Complications

Key Symptoms and Complications	Potential Causes/Risk Factors	Potential Treatments
Metabolic bone disease Osteomalacia Osteopenia Osteoporosis	Low body mass index Vitamin and mineral deficiencies Corticosteroid use Chronic metabolic acidosis	• Periodic assessment of bone mineral density (~2-3 years) • Calcium, magnesium, and vitamin supplementation • Metabolic acidosis correction • Specific osteoporosis treatments
Intestinal failure-associated liver disease Steatosis Cholestasis Fibrosis Cirrhosis	Small bowel segment < 50 cm Colon not in continuity or absent Absence of oral or enteral intake Intra-abdominal inflammation Recurrent CRBSI/sepsis SIBO Underlying liver disease	• Avoid excesses and deficiencies in the PN formula • Limit intravenous lipid dose < 1 g/kg/d • Reduce/ eliminate soybean-based IV lipid emulsion • Use non-soybean-based IV lipid emulsions • Cycle PN • Increase oral/enteral intake • Identify/ treat sepsis and/or SIBO
Cholelithiasis	Incompletely understood Altered enterohepatic circulation Hormone-related altered motility	• Prophylactic cholecystectomy when abdominal surgery is being undertaken for other reasons • Consider UDCA in nonsurgical patients

Bering J, DiBaise JK. *Nutr Clin Pract*. 2023;38(Suppl 1):S46-S58.

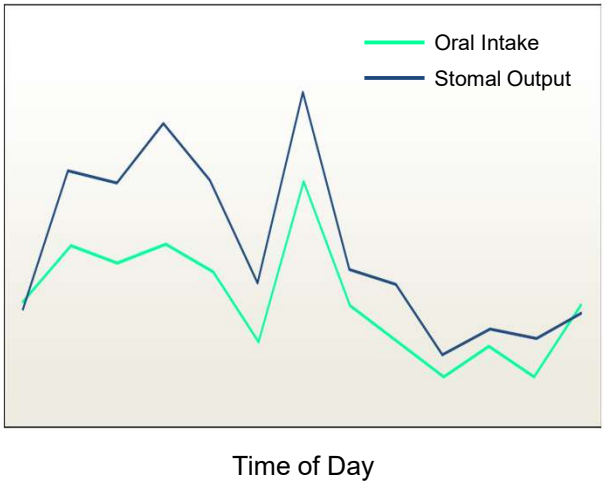
30

30

Challenge #1: Net secretor

- Stool output (mL) > PO intake (mL)
- Most commonly with high output jejunostomy (> 1.5 or 2 L/d)
  - Large fluid and Na, K, Mg, Ca losses in the stool
  - Volume depletion can contribute to nephrolithiasis and acute/chronic renal injury
  - Major cause of morbidity and hospitalization

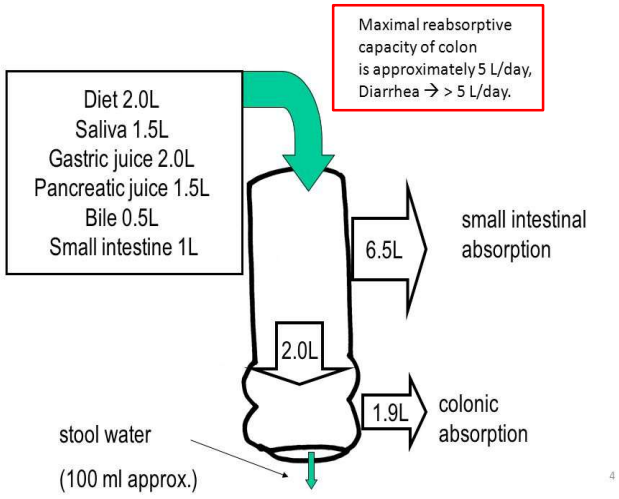
Mature ileostomy
- After 2-3 months
- 500 mL (> 1 L/d initially)
- Low sodium (50 mEq), chloride (50 mEq), bicarbonate (25 mEq)

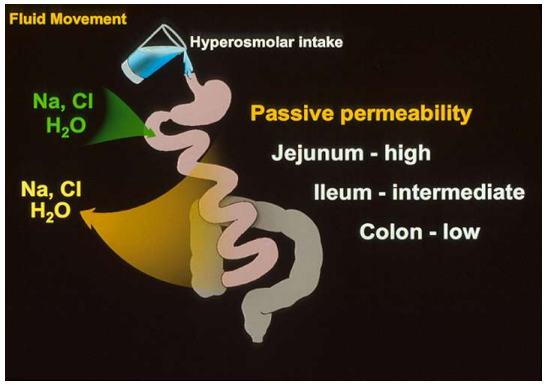


Nightingale JMD. *Lancet* 1990; Nightingale J et al. *Gut* 2006; Messaris E et al. *Dis Colon Rect* 2012

31

Intestinal Fluids and Flux





32

Net Secretor Treatment

- **Stage 1**
  - Exclude SBO, intra-abdominal sepsis, meds, enteric infection
  - Initiate antidumping diet
  - Restrict oral fluids (500mL) – may need IVF
  - Begin loperamide 4mg QID (ac/hs)
  - Monitor fluid balance (goal urine output > 800mL/d), body weight, electrolytes
    - Reassess after 48-72 hrs – if better, increase PO intake
- **Stage 2**
  - Continue Stage 1 items
  - Begin ORS (90 mmol/L sodium) – 0.5 to 1L/d
    - Consider checking urine sodium (goal > 20mEq/L)
  - Increase loperamide to 4 tabs QID
  - Begin PPI once-twice daily
  - Continue close monitoring
  - May need to begin magnesium supplementation (PO or IV)
- **Stage 3**
  - Add codeine 15-60mg QID (ac/hs)
  - ? Increase loperamide dose and ORS volume
  - Try octreotide 200mcg SC TID for 3-5 days if stool output still >2L/d
  - Stop if no benefit seen
  - Review compliance
  - May need parenteral fluid support long-term

Oral Rehydration Solution "Pearls"

- Start with 500-1000 mL/day
- Sipping is better than gulping
- Try it as ice cubes/popsicles
- Via nocturnal feeding tube
- Commercial and ORT-like recipes

Baker ML et al. *Colorectal Dis* 2010;13:191-197; De Vries FEE et al. *Alim Pharmacol Ther* 2017;46:266-273

33

Challenge #2: Hypomagnesemia in SBS

- Magnesium absorption occurs throughout the gut but mainly distal ileum/colon
- Occurs in 45% of patients with high output stoma
- Multifactorial pathogenesis
  - Loss of absorptive area
  - Chelation with unabsorbed fatty acids in the gut lumen
  - Increased renal excretion due to secondary hyperaldosteronism
  - Increased renal excretion due to reduced secretion of PTH
  - Decreased jejunal absorption due to reduced production of 1,25 hydroxyvitamin D

69% of patients with < 200cm of SB will require long-term supplementation

Baker ML et al. *Colorectal Dis* 2010;13:191-197

34

Hypomagnesemia

- May cause fatigue, cramping, tetany, tremor, weakness, apathy, disorientation, convulsions, psychosis, coma, hyperreflexia, ECG abnormalities
- **Hypocalcemia** and **hypokalemia** may develop as a consequence and are typically refractory to supplementation until magnesium repleted

Magnesium acts as a stabilizer of ATP-dependent enzymatic reactions, cofactor of many enzymes, modulator in neuromuscular transmission and cardiac physiology

35

General Treatments of Hypomagnesemia

- Correct metabolic acidosis (increase urinary wasting)
- Correct vitamin D deficiency
  - Oral 1α-hydroxycholecalciferol (e.g., calcitriol)
- Rule out hyperthyroidism (aggravate mg depletion)
- Slow intestinal transit
  - Reduce stool/ostomy output by 20-30%
- Lessen steatorrhea
- Review medication list (e.g., PPI use)
- Correct secondary hyperaldosteronism (increase urinary wasting)
- Control blood glucose (hyperglycemia can increase mg loss)

36

Treatment of Hypomagnesemia

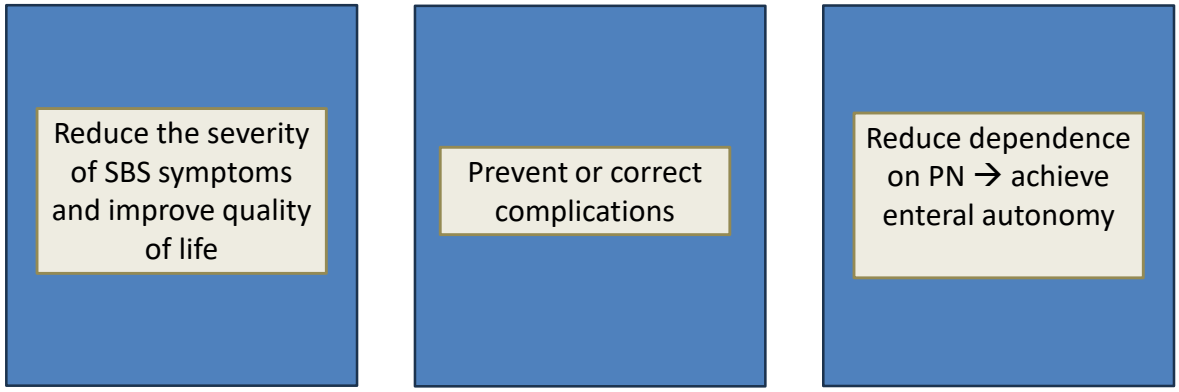
- **Serum levels 1.0-1.5**: oral supplementation
  - Mag oxide 400mg 2 tablets (about 40mEq/d; cathartic dose > 100mEq/d)
  - Mag gluconate 500mg About 17 tablets
  - Mag glycinate 400mg Best absorbed, less diarrhea
  - Mag chloride (Slow-Mag) 7.5 tablets
  - Mag hydroxide (MOM) 15 mL
- **Serum levels < 1.0 or symptomatic**: parenteral supplementation
  - Magnesium sulfate 1-2 g IV (about 8-16 mEq) best when infused slowly (8-12 hrs recommended to prevent exceeding the renal threshold)

Magnesium heptogluconate (gluconate) (30 mEq/L) In ORS sipped throughout the day

Chagas E et al. *Gastroenterology* 2003;124:A430 (abstract); Fukumoto S et al. *J Clin Endocrinol Metab* 1987;65:1201-1204.

37

Goals of SBS Treatment



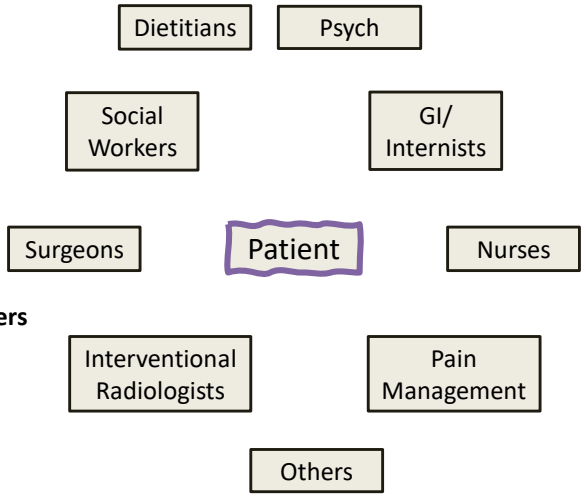
Parrish CR, DiBaise JK. *Gastroenterol Hepatol (NY).* 2017;13(10):600-608; Iyer K, et al. *Clin Gastroenterol Hepatol.* 2022;20(10):2185-2194.

38

38

Multidisciplinary Team Approach

- The overall care of these patients is complex with multiple physical, psychosocial, economic and other issues
- Diverse areas of expertise: GI, dietitian, nurse, pharmacist, surgeon, wound-ostomy care, IR, psych, pain, social work, etc
  - **In collaboration with local health care providers**
- If managed appropriately, particularly if receiving PN, there may be an improved quality of care, cost savings and survival



Pironi L, et al. *Clin Nutr* 2012;31:831-45

39

Treatment Options for SBS

- Diet modifications
- Fluid modifications
- Conventional medications
  - Antimotility
  - Antisecretory
  - Bile acids
  - Antibiotics
- Trophic factors
- Nutrition support
  - Parenteral
  - Enteral
- Surgery
  - Autologous GI reconstruction
  - Transplantation

40

Factors to Consider for Individualized SBS Management

- Length and function of remaining bowel
- Underlying bowel disease
- Clinical phase and complications
- Diet, fluid, drug, PN optimization
- Trophic factor use, when applicable
- Surgery, when applicable

Bering J, DiBaise JK. *Am J Gastroenterol.* 2022;117:876-883; Cuerda C, et al. *Clin Nutr*. 2021;40:5196-5220.

41

Initial Nutrition Asse Involve an experienced dietitian

❑ Weight change history
❑ Medication usage, including supplements
❑ Presence of gastrointestinal and other symptoms that may affect oral intake or fluid loss
❑ Food diary to determine usual oral diet and daily energy intake
❑ Potential symptoms of micronutrient deficiencies
❑ Pertinent past medical and psychiatric comorbidities
❑ Pertinent surgical history including the presence of bowel complications such as anastomotic strictures, chronic obstruction, enterocutaneous fistulae, and peritoneal drains
❑ Prior/ current enteral and/ or central venous access device, formula used, route and method of administration and complications
❑ Physical assessment for signs of dehydration, malnutrition, and micronutrient deficiency
❑ Laboratory studies including complete blood count, chemistry panel, and micronutrient levels
❑ Bone mineral density

42

42

Ongoing Nutrition Monitoring

- Regular monitoring of **renal function and fluid balance**
  - Urine output of >1 L/day and urinary sodium concentration >20 mEq/L
- Serial **weight** measurements as a warning of compromise
- Serum **micronutrient levels**
  - Measure at least annually depending upon the presence of existing/prior deficiencies
- **Bone density** testing
  - Baseline and every 2–3 years; sooner if treatment changes made in the osteoporotic

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20(10):2185-2194.

43

Diet Modification in SBS

- Focus on **compensatory hyperphagia** rather than excessive restrictions
- Some recommendations differ for patients with colon and those without

General	• Educate and monitor • 4-6 small meals/snacks per day; chew foods well • Tailor diet to individual
Fluids	• ORS and/or hypotonic; avoid hyperosmolar • **In some, all fluids may need to be limited & IV given**
Carbohydrates	• Complex CHO; **limit simple sugars & sugar alcohol in both foods/fluids; lactose okay if tolerated**
Fat	• Limit fat to <30% in those w/ a colon; may need to limit in those without; ensure oils w/ essential fatty acids
Protein	• High-quality protein at each meal
Fiber	• Soluble fiber is good in those with a colon segment
Oxalate	• Limit in those w/ a colon; **ensure adequate urine output first**
Salt	• Usual intake in those w/ colon; **increased salt intake**

Byrne TA, et al. *Nutr Clin Pract.* 2000;15:306-311.

44

Fluid and Electrolyte Management

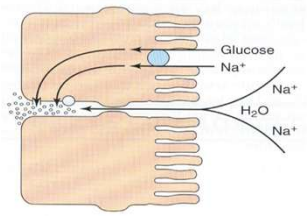
Glucose-Electrolyte Solution / Oral Rehydration Solution (ORS)

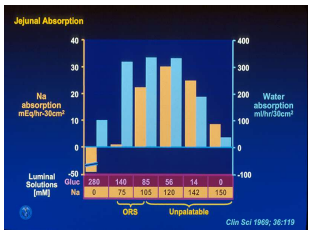
Uses the sodium-glucose–coupled transport system to:

- Enhance jejunal absorption
- Reduce gastrointestinal secretion

Adequate hydration = UOP > 1 L/d and urinary sodium concentration > 20 mEq/L

ORS ≠ Commercial Sports Drinks





Bering J, DiBaise JK. *Am J Gastroenterol.* 2022;117(6):876-883.

When To Consider IV Fluids Versus PN in SBS

- Weight loss/malnutrition, dehydration, AKI, symptomatic electrolyte derangements, failure to thrive may occur
  - Recurrent hospitalizations
  - EN not feasible (stool output > 1.5 to 2 L/d)
- IVF alone with or without electrolytes
  - Symptomatic electrolyte deficiencies without weight loss or dehydration
- When acute illness (stool output acutely worse) or during hot Summer months
  - Increased fluid/electrolytes may be needed
- IVF sometimes still needed in patients successfully weaned from PN

Worthington P et al. *JPEN* 2017; Iyer K and DiBaise JK. *Clin Gastroenterol Hepatol* 2022

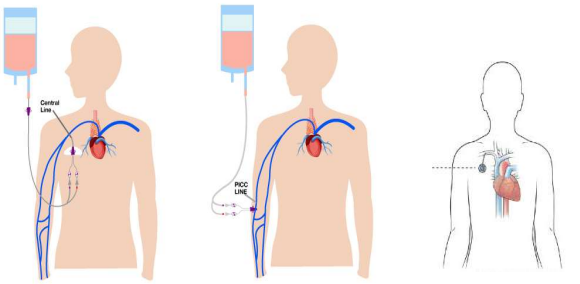
Parenteral Nutrition in SBS

Vast majority of patients will initially require PN at hospital and transition to home

- **> 50%** of adults wean from PN within 5 years of SBS onset
- **< 6%** chance of total independence from PN if successful weaning is not accomplished in the first 2 years following last resection

Occasionally, PN is not provided after discharge

- Progressive weight loss and macro- and micronutrient deficiencies not uncommon
- Acute/chronic dehydration with acute/chronic kidney injury may occur



Tunneled central venous catheters

Peripherally inserted central venous catheters (PICC)

Implanted port

Complications: catheter-related infections, vascular thrombosis, liver disease, gallstones

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20(10):2185-2194; Cleveland Clinic. Parenteral Nutrition. https://my.clevelandclinic.org. Accessed 9/27/24

47

PN Weaning

- 30-50% weaned completely within 5 years
- < 6% weaned if not done in first 2+ years

- **Definition**: Safe and durable transition from PN to another form of nutrition (PO, EN, IVF)
  - Resume more normal lifestyle and improved QoL
  - Reduce complications and improve survival
- **Goal**: To provide the minimum amount of parenteral support needed to maintain weight/hydration
  - Set realistic goal – reduction may be complete but is often only partial
- Requires motivated and adherent patient who recognizes the trade-off of not being on PN – increase PO/meds/expenses
- May commence when patient is clinically stable and nutritionally optimized
- Entails gradual reduction of PN volume and/or calories
- Monitoring of nutrition/hydration parameters

Amiot A, et al. *Clin Nutr* 2013; D'Eusebio C, et al. *Nutrition* 2023; DiBaise JK, et al. *J Clin Gastroenterol* 2006

48

Enteral Nutrition

More commonly used in pediatric population

May enhance intestinal adaptation
May promote reversal of IFALD

Slow continuous nocturnal infusion into stomach preferred over bolus administration or infusion into small bowel

Consider EN in combination with oral feeding in stable SBS-IF patients, when:
- Oral intake is inadequate
- Stool output < 1.5 to 2 L/day
- Expected benefit of TF allows for weaning of PN

Billiauws L, et al. *J Visc Surg*. 2018;155(4):283-291; Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol*. 2022;20(10):2185-2194.

SBS Pharmacotherapy

- Can be divided into conventional/symptomatic agents and SBS-specific agents
  - Symptomatic agents generally focus on diarrhea/excessive stoma output
  - SBS-specific agents promote intestinal adaptation and absorption
- Symptomatic agents should be used aggressively as first-line agents
  - Anti-motility and anti-secretory medications

Drug Dosing in SBS

- Drugs should be prescribed to SBS patients recognizing the absorptive capacity of the remaining bowel and the pharmacologic properties of the drug
- Whenever possible, drug dosing should be titrated according to measurable clinical effects or measurement of plasma concentrations

- Most oral meds absorbed within the first 60 cm of jejunum
- **Sustained- and delayed-release medications should be avoided**

When lack of clinical response consider
- Escalating the dose
- Changing to a different dosing schedule
- Changing to a different drug formulation or route of administration
- Monitor drug levels when applicable

Iyer K, DiBaise JK et al. *Clin Gastroenterol Hepatol.* 2022;20(10):2185-2194.

51

Antisecretory Agents

Hypersecretion and hypergastrinemia may last 6-12 months following surgical bowel resection

AGENT	FORM	CLINICAL CONSIDERATIONS
Histamine-2 receptor antagonists (H2RA)	Oral or IV	• Compatible with PN solution • Loss of efficacy with long-term use
Proton pump inhibitors (PPI)	Oral or IV	• Requires adequate small bowel surface area for oral absorption • If efficacy is in question, try IV route (and stop oral route) • Cannot be added to PN • Increased risk of *Clostridioides difficile* • Potential for hypomagnesemia • Re-evaluate need at 6-12 months
Octreotide (somatostatin analog)	SC or IV ? Add to PN	• Overused in clinical practice; reserve for secretory diarrhea • Risk of hyperglycemia and cholelithiasis • Painful and expensive • May inhibit intestinal adaptation
Clonidine	Oral or patch	• Risk of hypotension

Parrish CR, DiBaise JK. *Gastroenterol Hepatol (NY).* 2017;13(10):600-608.

52

52

Antimotility Agents

AGENT	FORM	CLINICAL CONSIDERATIONS
Loperamide	Oral: liquid, tablet, capsule	• Limited effects on the central nervous system • Enterohepatic circulation of loperamide can be disrupted with extensive ileal resection (high doses needed)
Diphenoxylate/atropine	Oral: liquid, tablet	• Atropine crosses blood-brain barrier; careful use in elderly patients • Atropine discourages drug abuse by anticholinergic events if > 10 tablets
Codeine	Oral: liquid, tablet	• Avoid use of codeine/acetaminophen combinations due to the risk of acetaminophen toxicity • CYP2D6 genotyping may need to be considered
Tincture of opium	Oral: liquid	• Not available in all pharmacies • Not always covered by insurance • Always dose in mL – not in drops • Caution should be taken when eyesight is poor • Costly • Patients dislike the taste

Parrish CR, DiBaise JK. *Gastroenterol Hepatol (NY).* 2017;13(10):600-608.

Other Conventional Pharmacologic Options

TREATMENT	COMMENTS
Antimicrobials	• Used to treat SIBO • Consider for those with persistent flatulence, bloating, and diarrhea
Clonidine	• Alpha2-adrenergic receptor antagonist action can slow intestinal transit and reduce stool volume • Long-term benefit unproven
Bile acid sequestrants	• Can worsen steatorrhea in SBS • Should generally be avoided in SBS
Pancreatic enzyme replacement	• No current evidence of benefit
Ursodeoxycholic acid	• No current evidence of benefit

Bering J, DiBaise JK. *Am J Gastroenterol.* 2022;117:876-883.

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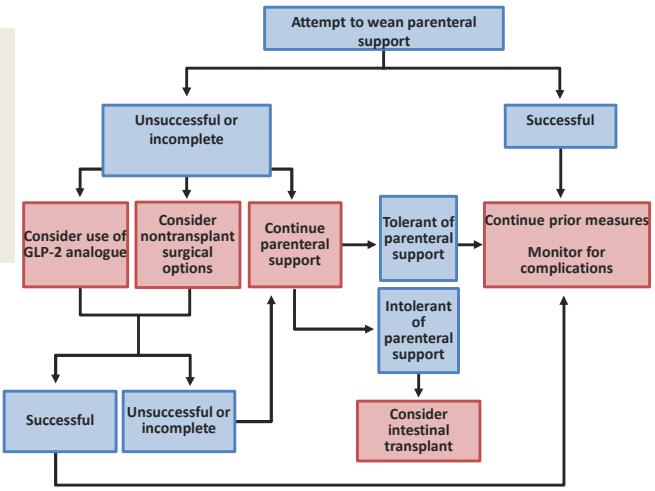
Problem With Current Approaches

- Parenteral nutrition is still frequently necessary
  - Does not enhance bowel function
  - Costly (>$100K/year)
  - Reduced quality of life
  - 1 to 2 hospitalizations annually/patient



Howard L, et al. *Gastroenterology*. 1995;109:355-365; Tokars JI, et al. *Ann Intern Med*. 1999;131:340-347; Iyer K, DiBaise JK. *Clin Gastroenterol Hepatol* 2022.

55

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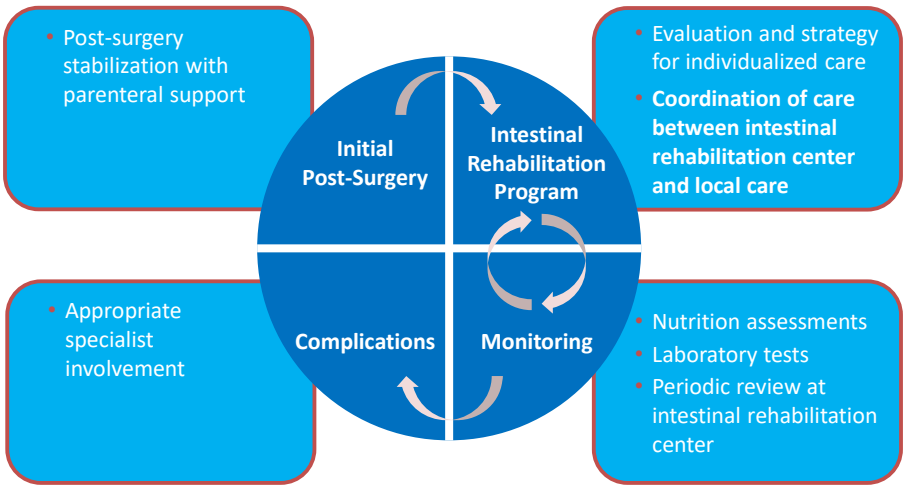
Benefits of Multidisciplinary Team Care



Matarese LE, et al. *JPEN J Parenter Enteral Nutr.* 2014;38(suppl 1):60S-64S.

56

Who to Refer to a Multidisciplinary Team

- Any patient with intestinal failure may benefit
- Those patients with complicated conditions
  - Surgical complications – ECF, SBO, high output stoma/net secretor
  - Recurrent CRBSI
  - Loss of central venous access
  - Worsening liver tests/function
  - Difficulty weaning parenteral support
  - Difficulty managing fluids, electrolytes, acid-base disturbances
  - Need for specialized medical/surgical therapies
  - Frequent hospitalizations, inadequate response to standard therapies, refractory symptoms

57

Education and Support for SBS Patient/Caregiver

- Encourage ongoing **education** for patients and caregivers
  - Importance of sterile technique and CVC care
  - Importance of monitoring (s/sx complications, weight, temperature, UOP, BS)
  - Treatments available and rationale for use
  - Availability of support groups and networking opportunities
- Encourage their **participation in sources of psycho-social support**
  - Physical burdens
  - Psycho-social burdens
  - Financial burdens
  - Frequent dependence on intrusive chronic therapy in the form of PN

58

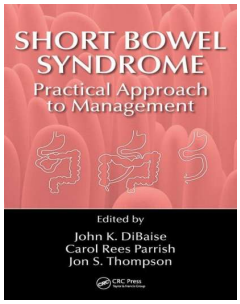
Resources for Patients and Clinicians

NORD®

Short Bowel Syndrome Foundation

LIFT-ECHO
Learn Intestinal Failure TeleECHO

The Oley Foundation
Help along the way



59

Case Scenario Continued

Management:

He is hospitalized and PN is initiated after placing a single-lumen tunnel central venous catheter

Electrolytes are corrected and micronutrient supplementation initiated

He is educated on an appropriate SBS diet and use of an oral rehydration solution

A PPI is started BID as is loperamide 2 tablets before meals and at bedtime

Follow-up:

6-months later, he is back to his usual body weight of 62 kg and feeling much better

Routine labs and micronutrient levels are normal

Urine output is > 1 L/d and ostomy output is usually 1-1.5 L/d with no leakage

He is back to light-duty employment but complains of the effect of PN on his quality of life and would like to wean it

60

Case Scenario Conclusion

- Options of restoring colon continuity and use of teduglutide discussed (including potential risks, expense, monitoring required, and potential lifelong need of teduglutide)
- Due to his concern of uncontrollable diarrhea and incontinence, he decided to try teduglutide
- With daily teduglutide, after 3 months, he was able to get down to 4 nights of PN per week but was unable to decrease further due to electrolyte derangements and weight loss
- He's reconsidering the ostomy takedown
- Routine lab and periodic micronutrient and bone density monitoring continue as do use of the SBS diet, ORS, and medications/micronutrient supplements

61

Key Takeaways

- Short bowel syndrome is a complex condition with significant impact on quality of life
- Classifying the remnant anatomy is crucial to guiding management decisions and alerting to potential risks
- Familiarity with the potential complications is important in both their prevention and treatment
- Regular monitoring of renal function and fluid balance, body weight, micronutrient levels, and bone density is recommended
- Reducing dependence on parenteral nutrition is a main treatment goal
  - Nutrition and hydration therapies are important in the management
  - Aggressive use of conventional antimotility and antisecretory drugs is considered first-line therapy
  - Pharmacologic intestinotrophic treatment and surgical options available
- Encourage patient/caregiver education and participation in sources of psycho-social support
- Multidisciplinary care should be employed to manage and mitigate SBS-related and PN-related complications
  - Consider referral to center of excellence when feasible

62

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Tips To Avoid When Managing Chronic Intestinal Failure

- Not recording/recognizing the remaining bowel anatomy
- Telling the patient with high stoma output to drink more
- Not recognizing high stoma output (> 1.5 L)
- Not recognizing early signs of sepsis
- Missing IFALD until it is too late
- Not monitoring electrolytes/micronutrients
- Not involving an experienced dietitian in the management plan
- Not referring complicated patients to a multidisciplinary program

- Not optimizing antisecretory and antimotility medication usage
- Using bile acid binders in patients with a jejunostomy/ileostomy
- Providing too much lipid, dextrose, kcals in PN
- Not considering use of growth factors in SBS management
- Not restoring bowel continuity when possible

63

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Questions

John K. DiBaise, MD, FACG

Dejan Micic, MD, FACG

64


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65