Seeking Enteral Autonomy: 
Managing the Patient with Short Bowel Syndrome

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2016 Mid-Atlantic Region WOCN, Richmond VA

I have the following relevant relationship(s) to disclose:
Shire Pharmaceuticals for book publishing.

Learning Objectives
• The participants will be able to:
  1) Explain the factors that contribute to high stool output in SBS
  2) Appropriately select and dose medications to enhance absorption and decrease stool volume.
Case
70 y/o sharp, active, very compliant F presents to GI nutrition clinic
- SBS from Crohn’s: 128cm SB distal to L.O.T. with end jejunostomy
- 24 hour ostomy volume = 1500-2200mL; UOP - unknown
- BUN/creat = 47/1.3; 1 month ago after IV fluids BUN/creat: 28/0.9
- Ht: 5’4” Wt: 102# UBW: 120#
- Nutrition/Hydration Regimen:
  - Oral diet: short bowel, 5 meals & snacks, 1 liter ORS sipped over day
  - Nocturnal PN added 3 days/wk 1 month ago when “renal function declined”
  - Lactated ringers “prn”
  - Enteral feeding: 1.5 cal/mL product @ 100mL/hr overnight until 4 cans infused

Meds (= 33)
- 30 min before breakfast:
  - 1 pepcid, 2 lomotil, opium tincture 0.6 ml
- With breakfast:
  - 1 claritin, lactaid tablet, chewable vitamin, 2 cranberry extract, 1/2 lopressor
- 30 min before lunch:
  - 1 claritin, lactaid, ferrous sulfate liquid, opium tincture 0.6 ml
- With lunch:
  - 1 calcium, lactaid, 2 cranberry extract, liquid vitamin D drops, chewable vitamin
- 30 minutes before dinner:
  - 1 pepcid, 2 lomotil, lactaid, opium tincture 0.6 ml
- Bedtime:
  - 1 claritin, 2 lomotil, opium tincture 0.6 ml, 1/2 lopressor, Lipitor (?), Keflex

Etiology of SBS & High Output Stomas in Adults
- Complications from abdominal surgery
  - > incidence of SBS with laparoscopic vs. open procedures
  - Hernia repairs
  - Bariatric surgery
  - Volvulus
- Malignancy - tumor resection
- Mesenteric ischemic events
- Crohn’s disease
- Trauma
- Other
When Does it Present a Problem?

- Unable to maintain nutrition, hydration, & micronutrient status while eating/drinking a normal diet & fluids
- Wide range in *normal* SB length: 300-800cm
  - Problems arise when > 75% removed (< 200cm remaining)
  - Medicare criteria is <150cm
- Note: remaining colon = 50-60cm SB

Contributors to Diarrhea & Malabsorption

- Loss of absorptive surface area
- Loss of feedback mechanisms leading to:
  - Dumping into upper gut
  - Accelerated intestinal transit
  - Poor mixing of pancreatico-biliary secretions with food
  - Gastric hypersecretion
    - Sheer volume of gastric secretions
    - Lower pH entering upper gut deactivates pancreato-biliary secretions
- Ongoing or new medical issues
  - Inability to control primary disease, C. diff., small bowel bacterial overgrowth

Clinical Translation

- Diarrhea
  - Steatorrhea/malabsorption
  - Malnutrition
  - Nutrient deficiencies
  - Metabolic bone disease
  - Dehydration
  - Electrolyte disarray
  - Metabolic acidosis
  - Bacterial overgrowth
  - Nephrolithiasis
  - Cholelithiasis
  - Cholerrheic (bile salt) diarrhea
    - Only in those with colon segment
  - Medication malabsorption

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Factors Enhancing Adaptation & Absorption

- Intact, luminal nutrients
- Length & quality of remaining bowel
- Which segments of SB remain
- Intact colonic segment
- Age of patient (?)
- Integrity of other organs
- Time elapsed since original insult
- Depending on interventions to date.
- Patient adherence to therapies


Data Collection

- GI anatomy
  - Op reports/ reliable drawing
  - Small bowel follow through (SBFT)
  - Idea of gross anatomy & transit time
  - Abdominal CT
- Past medical/surgical history


Assessment for Dehydration

- Urine output <1000mL/day
- Stool output >1500-2000mL/day
- Rapid weight loss
- Dark urine
- Chronic fatigue
- Hypotension
- Dehydration admits?
- Recurrent kidney stones
- Decline in kidney function
- Light-headedness on standing
- Thirst, dry mouth
- Thick saliva

Common Causes of Increased Stool Output

- C. difficile/other GI infection
- Initiation of a new medication
- Sudden discontinuation of important gut slowing med
  - Pt runs out & forgets to inform health care team…
- Drinking too much fluid or poor fluid choices
- New hyperthyroidism
- Recurrent/active disease
- “Outflow” diarrhea from stricture/obstructive process

Data cont.

- Baseline 24 hour I & O:
  - Urine
    - Goal = 1200mL; stone formers ≥ 1500mL
  - Stool/ostomy
    - Goal = < 1500mL
  - 24 hour fast
    - Differentiate osmotic vs. secretory
      - NPO x 24 hours w/ strict measurement of stool output
  - 48 - 72 hour quantitative fecal fat:
    - 100g fat/day diet or enteral feeding during collection period

Goals of Therapy

- Maintain nutritional status
- Maintain appropriate weight
- Maintain hydration
- Slow motility
  - ↑ nutrient contact time
  - ↑ absorption
  - ↓ stool/ostomy output
  - ↑ urine output
- All else falls in line
Survey Results SBS Patients Entering Bowel Rehab Program

- Had received little prior dietary instruction from healthcare providers
- Were making food and beverage choices that would:
  - ↑ stool output
  - ↑ parenteral nutrition requirements


Diet Guidelines1-3,6

<table>
<thead>
<tr>
<th>Topic</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>General Tips</td>
<td>• 6-8 small meals/snacks per day—start with 2-3 day diet record</td>
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<tr>
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<td>• Tailor diet to individual—tell them what they can eat!</td>
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<tr>
<td></td>
<td>• Chew foods well</td>
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<td></td>
<td>• Written diet materials for SBS available @ <a href="http://www.ginutrition.virginia.edu">www.ginutrition.virginia.edu</a></td>
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<tr>
<td>Fluids</td>
<td>• Oral rehydration solutions</td>
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<td>• Fluids may need to be limited in some pts &amp; IV fluids given</td>
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<tr>
<td>Carbohydrates</td>
<td>• Generous complex CHO intake (pasta, rice, potatoes, breads, etc.)</td>
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<tr>
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<td>• Limit simple sugars &amp; sugar alcohols in BOTH foods/fluids; limit lactose &amp; lactaid milk</td>
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<td>• NO ENSURE/BOOST etc...</td>
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<td>Fat</td>
<td>• Limit fat to &lt; 30% in those w/ a colon; may need to limit in those without</td>
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<td>• Ensure oils w/ essential fatty acids included (sunflower, soybean, corn, walnut)</td>
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<tr>
<td>Protein</td>
<td>• High quality protein at each meal &amp; snack</td>
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<tr>
<td>Fiber</td>
<td>• Encourage some fiber (in foods) in those w/ a colon segment</td>
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<tr>
<td>Water</td>
<td>• Limit in those w/ a colon; ENSURE adequate urine output first</td>
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<tr>
<td>Salt</td>
<td>• Usual intake in those w/ a colon; ↑ salt intake in those without</td>
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Bulk Forming Agents & Jejunostomies / Ileostomies

- In stable well-nourished pts that want to try them—ok...
  - Can ↑ viscosity of effluent & may improve quality of life in some.
- In pts w/ poor intake, don’t fill them up on this!
- May exacerbate water/electrolyte depletion depending on type & amount of fiber used.
- Can ↑ bile salt loss (by entrapment of whole micelles in gut ?)
  - May affect fat and fat soluble vitamin absorption.
- Does not improve hydration of pts.
**Fluids/Hydration**

- **Hypertonic fluids**
  - Fluids that pull water into the SB lumen to dilute the higher osmotic fluid, increasing stool volume
  - Examples: fruit juices & drinks; sodas, sweetened liquid nutritional supplements, sweetened tea, ice cream, sherbet

- **Hypotonic fluids**
  - Fluids that pull sodium into the SB lumen to increase the osmolarity of the fluid, and along with it, water, increasing stool volume
  - Water, tea, coffee, alcohol, diet drinks

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**Fluids/Hydration cont.**

- Take small amounts of fluids with meals
- Sip more between meals
- Demonstrate to pt contribution of oral fluids to stool/ostomy output by:
  - Severely decreasing oral fluid intake for 24 hours
- Need to keep UOP > 1200mL/day
  - Add IV fluids
  - Infuse ORT/ appropriate fluid via PEG tube at night

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**3 Mechanisms of Water Movement in the GI Tract**

1) Passive absorption
2) Active absorption
   - Sodium-potassium ATP pump
3) Glucose-coupled transport
   - Coupling is obligatory
   - Permits 1 Na+ molecule w/ each glucose
   - Coupled transport is uni-directional

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Oral Rehydration Solutions (ORS)

- Are not for everybody…
- Start with 500mL/day
- Sipping is better than gulping
- Try as ice cubes/popsicles
- Commercial and ORT-like recipes available
  - “A Patient’s Guide to Managing a Short Bowel” (see resource section)

Vitamins & Minerals

- Little evidence for dosing
  - Consider:
    - Osmotic drag from so many pills (& fluid to take them)
    - Sheer cost
    - Time to take them all
  - Add therapeutic vitamin & mineral supplement
    - Chewable, crushed, or liquid form
    - Daily, twice daily—½ to 1 tab
  - B12/methylmalonic acid
    - High dose oral vs. SQ or IM monthly injections

Vitamin D & Bone Health

- Baseline DEXA scan, then as needed
- Baseline 25-OH vitamin D
- Vitamin D – alter dosing if cannot normalize
  - Higher daily dose, twice-daily, crushed tabs, liquid, etc.
  - Avoid 50,000 units weekly
- Sunlight/ UV light
  - Sunlight, Sperti lamp, tanning beds
- Calcium
  - Diet contribution & supplements (< 500mg/dose divided BID-TID)
Pharmacotherapy (Consider **ALL** medications)

- Prescription, over-the-counter, supplements, etc.
- Scheduled; **NOT** "PRN"
- Timing in relation to meals
- Dosing/ form
  - Tab, capsule, sustained or delayed-release?
  - Elixir/suspension: sugar alcohols?
  - Are you getting clinical efficacy?
  - Is medication available @ local pharmacy?
  - Are they still needed? -- **reevaluate**
- Periodically, do the **total pill count**

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<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Schedule</th>
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<tr>
<td>Prescription</td>
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<tr>
<td>Over-the-counter</td>
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<tr>
<td>Nutritional Supplement</td>
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<tr>
<td>Allergies</td>
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**Anti-Secretory Agents**

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<tr>
<th>Agent</th>
<th>Form</th>
<th>Clinical Considerations</th>
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</table>
| Histamine, receptor blockers | Oral / IV | - Renal function  
- Thrombocytopenia in critically ill patients |
| Proton pump inhibitors | Oral / IV | - Requires adequate SS surface area for oral absorption  
- If efficacy in question, try IV route (may oral)  
- May aggravate small intestinal bacterial overgrowth  
- Risk for C. difficile  
- Hypomagnesemia  
- Reevaluate need at 6 months |
| Omeprazole (sodium 5-methyl analogues) | SC or IV | - Gastric / clinical practice  
- Hypoglycemia, cholelithiasis  
- Painful and expensive  
- May inhibit intestinal adaptation |
| Cloditace | Oral | - Risk of hypokalemia  
- Rarely used |

**Anti-motility Agents**

- **Check for C. difficile first**
- Take 30-60 minutes BEFORE meals
- Every 6 - 8 hours, **NOT** QID or "prn"  
  - Take advantage of pt getting up at night (they are!)  
  - Pills ready at bedside with sip of water
- Endpoint?
  - Output’s too much (i.e., constipated/ stool thick)  
  - Pt is nauseated, mental status changes, sleepy, etc.

Antidiarrheal Agents

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<tr>
<th>Agent</th>
<th>Form</th>
<th>Clinical Considerations</th>
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<tbody>
<tr>
<td>Loperamide</td>
<td>Oral liquid, tablet</td>
<td>- Limited CNS effects &lt;br&gt; - Enhanced oral absorption of loperamide can be disrupted with extensive food ingestion</td>
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<tr>
<td>Diphenoxylate/ atropine</td>
<td>Oral liquid, tablet</td>
<td>- Atropine crosses blood-brain barrier; use with caution in elderly &lt;br&gt; - Atropine discourages drug abuse by anticholinergic effects if &gt; 10 tabs</td>
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<tr>
<td>Tinutrocter/OxyContin</td>
<td>Oral liquid</td>
<td>Not available in all pharmacies &lt;br&gt; Not always covered by insurance &lt;br&gt; Avoid use in elderly patients (NOT drops), caution when elderly poor &lt;br&gt; Constipation &lt;br&gt; Patients dislike taste immediately</td>
</tr>
<tr>
<td>Codeine</td>
<td>Oral liquid, tablet (crushed), liquid</td>
<td>Avoid use of codeine/cimetidine combinations &lt;br&gt; CYP2D6 genotyping may need to be considered</td>
</tr>
<tr>
<td>Morphine, immediate release</td>
<td>Oral tablet, liquid</td>
<td>Use with caution in patients with renal impairment/fluid disorders</td>
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Other Therapies Sometimes Attempted

- Pancreatic enzymes<br> Pancreatic insufficiency<br> Bile acid binders<br> Oral diet with <br> a colon

Use Selectively (if at all)

- Antibiotics (small bowel bacterial overgrowth)
- Probiotics Insufficient data to support its use
- Glutamine Insufficient data to support its use

Intestino-Trophic Agents
Recombinant Growth Hormone (rhGH):
Meta-Analysis of 5 Small Studies

- Patients receiving rhGH ± Gln:
  - ↑d weight & lean body mass
  - ↑d energy, fat, nitrogen absorption
  - ↓d PN volume, calories, number of PN infusions/wk
- Only rhGH+Gln grps maintained PN reductions at 3-months
- + Effects of rhGH on weight & energy absorption are temporary
  - ~ 5kg wt loss
- Evidence is inconclusive to recommend rhGH


Glucagon-like peptide-2 (GLP-2)
- Endogenous peptide released from the distal ileum/ proximal colon in response to enteral nutrients
- Acts locally
- Physiological effects:
  - Inhibits gastric acid secretion and emptying
  - Stimulates intestinal blood flow
  - Increases intestinal barrier function
  - Enhances nutrient and fluid absorption
  - May also ↓ bone resorption

Jeppesen PB. Curr Opin Endocrinol Diabetes Obes. 2015;22:14-20

Evidence for Teduglutide (TED) [GLP-2 Analog]

Pivotal Phase 3 Study

- Multicenter, Multinational, Double-blind, Placebo-controlled
- 86 PN-dependent SBS patients given SQ teduglutide
- % of pts with >20% ↓ in PN /wk at wks 20-24:
  - 63% vs. 30% in TED vs. placebo group respectively; p = 0.002
- ↓ PN in liters/wk (TED vs. placebo):
  - 4.4 vs. 2.3 L
  - 54% vs. 23% ↓d > 1 PN infusion day/wk
- All while maintaining weight & urine output ≥ 1000mL/day

Teduglutide Extension Studies

- 52 Weeks (n=52)
  - 0.05-mg/kg/d vs. 0.10-mg/kg/d dose:
    - 68% vs. 52% had a >20% volume reduction in PN
    - 68% and 37% reduction of ≥1 days of PN dependency
  - PN independence achieved in 4 pts
- Up to 2.5 years (n = 88)
  - 13 pts achieved full enteral autonomy
  - Long-term TED treatment resulted in sustained, continued PS reductions
  - Overall health/nutritional status was maintained with PS reductions


Considerations Before Using Trophic Agent

- Pt actually has SBS
- On PN/IV fluids ≥3 times/week for 1 year or more
- Pt has been educated & optimized on:
  - Diet/hydration therapy
  - Anti-secretory drugs
  - Anti-diarrheal drugs
- Absence of contraindications (active GI malignancy, strictures, active CD, etc.)
- Is adherent/reliable with therapies


“Tools” for our Patients
Resources

- UVAHS GI Nutrition Website
  www.ginutrition.virginia.edu with links to:
  - Under “Nutrition Articles”
    + Recent 6 part series on SBS in Practical Gastroenterology (see references at end)
  - Under Patient Education
    + Short Bowel Diet & Hydration Information

Resource available at no cost to patients & clinicians
@ www.shortbowelsupport.com

More Tools

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<tr>
<th>Date/Time</th>
<th>Weight</th>
<th>Stool Output</th>
<th>Urine Output</th>
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Silent Knight pill crusher

Mortar & Pestle

Hammer & Baggie
Available through CRC Press at:

June 2016

Patient Support Resources
- Oley Foundation
  www.oley.org
  (800/776-OLEY)
- Short Bowel Syndrome Foundation
  www.shortbowelfoundation.org
  (888-740-1666)

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References

References – Fiber and Ostomies

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### References Below Available @ www.ginutrition.virginia.edu