Short Bowel Syndrome – Diet, Hydration, and Treatment
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Learning Objectives
- Describe the physiological consequences of short bowel syndrome (SBS)
- Explain the functional changes associated with intestinal adaptation in SBS
- Describe the dietary strategies for reducing dependence on parenteral nutrition

Disclosures
- Shire Gattex publication advisory board
- The material presented is based on best known clinical evidence

Short Bowel Syndrome (SBS): Most common form of intestinal failure

<table>
<thead>
<tr>
<th>Possible causes of resection</th>
<th>Non-SBS causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular catastrophes (e.g., embolism/thrombus)</td>
<td>Complications of bariatric surgery</td>
</tr>
<tr>
<td>Complications of bariatric surgery</td>
<td>Trauma</td>
</tr>
<tr>
<td>Trauma</td>
<td>Malignancy</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Radiation enteritis</td>
</tr>
<tr>
<td>Radiation enteritis</td>
<td>Volvulus</td>
</tr>
<tr>
<td>Volvulus</td>
<td>Strengthened hernias</td>
</tr>
<tr>
<td>Strengthened hernias</td>
<td>Short bowel fistulas</td>
</tr>
<tr>
<td>Short bowel fistulas</td>
<td>Crohn’s disease</td>
</tr>
</tbody>
</table>

Intestinal failure may result from severe intestinal injury or disease through loss of absorption, dysmotility, or obstruction even if the bowel length is normal.

Surgical Resections and Short Bowel Syndrome

- Jejunostomy (end jejunostomy)
  - Type 1
  - Common reason for SBS
  - Jejunal output greatest after food and drink consumption

- Jejunocolic Anastomosis
  - Type 2
  - Common reason for SBS
  - Weight loss and severe undernutrition occur months

- Jejun-ileal Anastomosis
  - Type 3
  - Less common reason for SBS
  - >10 cm terminal ileum
  - If seen, manage as for jejunostomy

Diet Modification:
The Foundation of Therapy
- Nutrition prescription must be based on the remnant GI anatomy
- Most potent stimulus to intestinal adaptation

Nutrition prescription must be based on the remnant GI anatomy

Most potent stimulus to intestinal adaptation
### Comparison of Two Nutrition Prescriptions: Cornerstone of Diet Education

<table>
<thead>
<tr>
<th></th>
<th>Colon</th>
<th>No Colon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>50-60% of total calories (limit simple sugars)</td>
<td>40-50% of total calories (restrict simple sugars)</td>
</tr>
<tr>
<td>Protein</td>
<td>20-30% of total calories</td>
<td>20-30% of total calories</td>
</tr>
<tr>
<td>Fat</td>
<td>20-30% of total calories (primarily essential fats)</td>
<td>30-40% of total calories (primarily essential fats)</td>
</tr>
<tr>
<td>Fluid</td>
<td>Isotonic fluids or Hypo-osmolar fluids</td>
<td>Isotonic, high sodium oral rehydration solution</td>
</tr>
<tr>
<td>Soluble Fiber</td>
<td>5-10 grams / day (if stool output is &gt; 3L/day)</td>
<td>5-10 grams / day (if stool output is &gt; 3L/day)</td>
</tr>
<tr>
<td>Oxalates</td>
<td>Limit intake</td>
<td>---</td>
</tr>
<tr>
<td>Meals</td>
<td>5-6 meals per day</td>
<td>4-6 meals per day</td>
</tr>
</tbody>
</table>

Byrne et al. NCP 15:306, 2000

### Simple vs. Complex CHO

**LIMIT**
- Sugar
- Candy
- Cakes, cookies, pies
- Regular soda pop
- Jelly, jam, syrup
- Ice cream, sherbet
- Sorbet

**INCLUDE**
- Pasta
- Potato
- Breads
- Cereals
- Whole grains as tolerated
- Fruits and vegetables as tolerated

### Types of foods and the way the food is consumed affects absorption...

### 2400 kcal, 50% CHO, 20% Protein, 30% Fat

#### Breakfast
- 1 cup oatmeal
- 2 oz lactose-free milk
- 1 egg
- 1 English muffin
- 2 tsp margarine
- 1 tsp diet jelly
- 4 oz coffee
- Morning Snack
  - 1 bagel w/1/2 oz cheese
  - 1 tsp margarine
  - 1 small banana
  - 4 oz water

#### Lunch
- 3 oz baked ham
- 1/2 cup cooked rice
- 1/2 cup carrots
- 2 small dinner rolls
- 2 tsp margarine
- 4 oz water or diet soda

#### Dinner
- 4 oz roasted chicken
- 1 large baked potato
- 2 dinner rolls
- 2 tsp margarine
- 4 oz water or diet soda
- Evening Snack
  - 1 roast beef sandwich
  - 2 slices bread, 1 oz meat, 1 tsp mayo
  - 1 tsp mustard
  - 1 oz pretzels
  - 4 oz water or diet soda

#### Even Snack
- 3-4 cups popcorn
- 1 cup raspberry sorbet
- 12 oz diet soda

Byrne et al., NCP 15:309, 2000

### 2400 kcal, 50% CHO, 20% Protein, 30% Fat

#### Breakfast
- 8 oz orange juice
- 1 cheese and fruit-filled Danish

#### Lunch
- 1 thin slice cheese pizza
- 12 oz regular soda

#### Dinner
- 12 oz T-bone steak
- 1 large baked potato
- 1 cup spinach
- 12 oz beer
- 3-4 cups popcorn
- 1 cup raspberry sorbet
- 12 oz diet soda

Byrne et al., NCP 15:309, 2000
Oral Rehydration Solutions

Sodium-glucose Co-transport

Sodium Balance with Short Bowel Syndrome


Sodium Balance
(Na intake – fecal output) mMol/L

CHO
g/L
Na+
mEq/L
K+
mEq/L
HCO3 mEq/L
Osmo mOsm/L

ORS
WHO Standard Formula 20 90 20 30 310
WHO Reduced-Osmolality Formula 13.5 75 20 30 245
CeraLyte 70 40 20 30 235
CeraLyte 90 40 90 20 30 260
CVS Adult Electrolyte Solution 25 45 20
DripDrop 25 80 20 180 (citrate) 215
Janes Brothers 20 90 20 10 300
Pedialyte (Abbott) 25 45 20 30 300
Speedylite (Eirecaf Biohealth) 75 45 20 9 (citrate) 188
Trioral Rehydration Salts (Trifecta) 13.5 20 20 10 (citrate) 245

Sports Drinks
Gatorade 60 20 3 340
Gatorade 2 + ½ tsp salt 29 63 3 254

Prescription for ORS*

<table>
<thead>
<tr>
<th>ORS</th>
<th>CHO g/L</th>
<th>Na+ mEq/L</th>
<th>K+ mEq/L</th>
<th>HCO3 mEq/L</th>
<th>Osmol mOsm/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Potassium Water</td>
<td>1</td>
<td>Sodium Chloride</td>
<td>½ tsp</td>
<td>Bicitra solution* 2 tsp</td>
<td>Glucose polymer powder* (polycose) 4 TBSP</td>
</tr>
<tr>
<td>Low Potassium Water</td>
<td>1</td>
<td>Sodium Chloride</td>
<td>½ tsp</td>
<td>Polycitra solution* 3 tsp</td>
<td>Glucose polymer powder* (polycose) 4 TBSP</td>
</tr>
</tbody>
</table>

*By prescription
#Sugar-free artificial flavoring or sweetener

Recipe for ORS

1 liter water
½ teaspoon table salt
3 tablespoons sugar (sucrose)
1 teaspoon baking powder (or ½ teaspoon baking soda)
½ teaspoon 20% potassium chloride* or salt substitute*
Sugar-free artificial flavoring or sweetener

* By prescription
* Concentration: 7-14 mEq potassium per gram; one teaspoon: 5 grams (1/6 oz) = 35-70 mEq potassium

Recipe for ORS

1. Gatorade Base
   2 cups Gatorade
   2 cups water
   ½ teaspoon salt
2. Grape or Cranberry Juice
   ½ cup juice
   3 ½ cups water
   ½ teaspoon salt
3. Apple Juice
   1 cup juice
   3 cups water
   ½ teaspoon salt

Parrish, C. Pract Gastroenterol 2005; 14:67
### Oral Supplements

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Strength</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A-D-E</td>
<td>25,000 IU of A</td>
<td>1 tablet PO daily</td>
</tr>
<tr>
<td></td>
<td>1,000 IU of D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>400 IU of E</td>
<td></td>
</tr>
<tr>
<td>Calcium citrate</td>
<td>500 - 600 mg tablet</td>
<td>1 to 2 tablets PO TID</td>
</tr>
<tr>
<td>Magnesium lactate</td>
<td>84 mg tablet</td>
<td>1 to 2 tablets PO TID</td>
</tr>
<tr>
<td>Magnesium gluconate</td>
<td>1000 mg tab (or liquid)</td>
<td>1 to 3 tablets PO TID</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>20 mg tablet</td>
<td>1 to 2 tablets PO daily</td>
</tr>
<tr>
<td>Phos (NeutraPhos)</td>
<td>250 mg pkg</td>
<td>1 pkg PO TID</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>650 mg tablet</td>
<td>1 tablet PO TID</td>
</tr>
<tr>
<td>Chromium</td>
<td>100 µg tablet</td>
<td>1 to 2 tablets PO TID</td>
</tr>
<tr>
<td>Copper</td>
<td>3 mg tablet</td>
<td>1 to 2 tablets PO daily</td>
</tr>
<tr>
<td>Selenium</td>
<td>200 mg tablets</td>
<td>1 tablet PO daily</td>
</tr>
<tr>
<td>Zinc sulfate</td>
<td>220 mg tablet</td>
<td>1 to 3 tablets PO daily</td>
</tr>
</tbody>
</table>


### Enteral Nutrition and Combined Interventions: SBS Model

- N=15
- SBS > 3 months post surgery
- Macronutrient absorption increased in ETF and OCEF compared with OF alone
- total calories P <0.001
- lipids P< 0 .001
- proteins P<0 .001
- OF = oral feeding
- ETF = enteral tube feeding
- OCEF= oral combined with enteral feeding

*Joly F et al Gastro 2009; 136:824*

### References

- Parrish CR, DiBaise J, Part III: Hydrating the Adult Patient with Short Bowel Syndrome. Practical Gastroenterology

### Summary

**Takeaway * message:**

- There are a variety of techniques available to treat intestinal failure including diet, medications, hormonal therapy, surgical reconstruction and transplantation
- Goal: restore intestinal health in the safest most efficacious manner consistent with the patient’s lifestyle and wishes
- Diet is the foundation of therapy