


ACG Postgraduate Course 2009

**Short Bowel Syndrome**



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**Disclosure**

Relevant Financial Relationships  
None

Off Label Usage  
None

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**Learning Objectives**

- Discuss conventional management of short bowel syndrome
- Describe strategies to facilitate parenteral nutrition (PN) weaning

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### What Defines Short Bowel Syndrome?

- Wide ranging length
  - 300 to 650 cm
- Tremendous functional reserve
  - Problems when > 75% removed
- < 200 cm small bowel remaining

*“It is not how long it is, but what you do with it, my friend...”*  
*Anonymous, about 500 BC*



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### What Defines Short Bowel Syndrome?

“...characterized by the inability to maintain protein-energy, fluid, electrolyte, or micronutrient balances when on a conventionally accepted, normal diet.”

*O’Keefe S, et al. CGH 2006*

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### Etiology of SBS

#### Infants

- Congenital anomalies
  - Midgut volvulus
  - Gastroschisis
  - Atresia
  - Aganglionosis
- Necrotizing enterocolitis

#### Adults

- Postoperative (24%)
- Radiation enteritis/Tumors (24%)
- Mesenteric ischemic events (22%)
- Crohn’s disease (17%)
- Trauma (8%)
- Other (7%)

*Dabney et al. Am J Surg 2004*

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## Complications of SBS

- **Central line-related**
  - Infection
  - Occlusion
  - Breakage
  - Central vein thrombosis
- **PN-related**
  - Hepatic
  - Biliary
- **Altered bowel anatomy-related**
  - Chronic diarrhea
  - Malabsorption
  - Fluid/electrolyte disturbances
  - Micronutrient deficiency/excess
  - Oxalate nephropathy
  - Bacterial overgrowth
  - D-lactic acidosis
  - Renal dysfunction
  - Metabolic bone disease
  - Peptic ulcer disease

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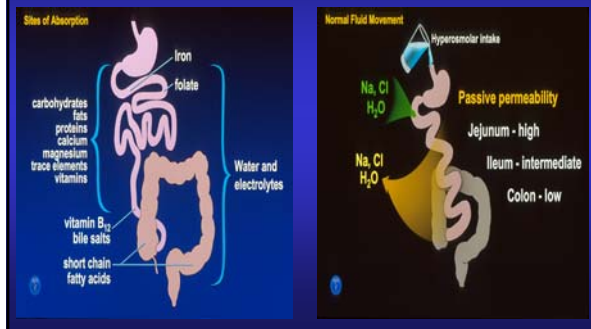
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## GI Tract Anatomy/Physiology Nutrient and Fluid Absorption



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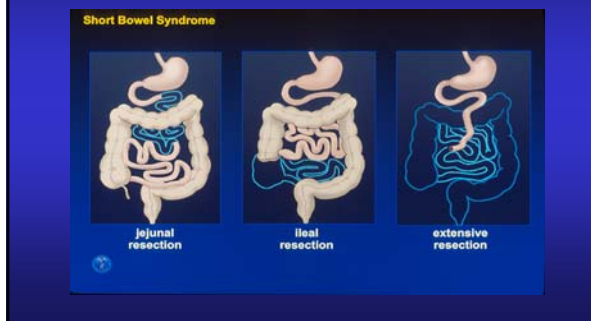
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## Bowel Anatomy Types in SBS



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## Treatment Goals in SBS

- Prevent and correct nutritional deficiencies
- Maintain adequate nutrition and growth
- Prevent and correct dehydration, diarrhea
- Prevent and correct complications
- Improve quality of life
  
- Restore enteral autonomy

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## Treatment Options in SBS

- Diet
- Fluids
- Medications
  - Antimotility
  - Antisecretory
  - Bile acids
  - Antibiotics
  - Trophic factors
- Nutrition support
  - Parenteral
  - Enteral
- Surgery
  - Autologous GI reconstruction
  - Transplantation

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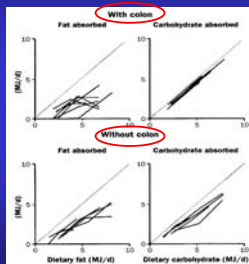
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## Diet in SBS

- Response to diet depends upon residual bowel anatomy
  - **Colon:** high CHO, low-moderate fat  $\pm$  MCT
  - **No colon:** high fat, moderate CHO



Norgaard et al. Lancet 1994  
Jeppesen et al. Gut 1998

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## Dietary Modification

### COLON PRESENT

- Encourage hyperphagia
- CHO 50-60%
- PRO 20%
- FAT 20-30%
- Meals 5-6 daily
- Avoid oxalates
- Isotonic/hypoosmolar fluids
- Soluble fiber 5-10 g/day
- Lactose as tolerated

### COLON ABSENT

- Encourage hyperphagia
- CHO 40-50%
- PRO 20%
- FAT 30-40%
- Meals 4-6 daily
- Oxalates: no restriction
- Isotonic, high Na fluids
- Soluble fiber 5-10 g/day
- Lactose as tolerated

Byrne et al. NCP 15:306, 2000

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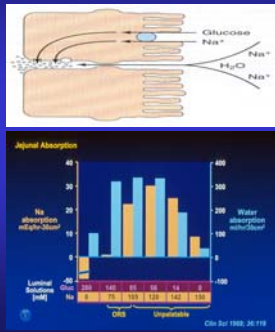
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## Fluids in SBS – Importance of ORS

- End-jejunosomy require glucose-electrolyte solution (ORS)
  - 90 mEq/L sodium
- Fluid composition less important to those with a colon
- All should avoid hyperosmolar fluids




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## Oral Rehydration Solutions

	CHO g/L	Na <sup>+</sup> mEq/L	K <sup>+</sup> mEq/L	HCO <sub>3</sub> mEq/L	Osmo mOsm/L
<b>WHO ORS</b>					
Standard Formula	20	90	20	30	310
Reduced-Osmolality Formula	13.5	75	20	30	245
<b>Rehydration Solutions</b>					
CeraLyte 70 (Cera Products)	40	70	20	30	235
CeraLyte 90 (Cera Products)	40	90	20	30	260
Equalyte (Ross)	30	78	22	30	305
Jianas Brothers ORS	20	90	20	10	300
Liquilyte (Gerber)	25	45	20	30	250
Pedialyte (Ross)	25	45	20	30	300
Rehydralyte (Ross)	25	75	20	30	300
<b>Sports Drink</b>					
Gatorade		60	20	3	340

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### Antisecretory Agents in SBS

- Massive enterectomy associated with transient (6-12 mo) hypergastrinemia and hypersecretion
- H<sub>2</sub>RA or PPI may be beneficial

*Cortot et al. N Engl J Med 1979*

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### Somatostatin Use in SBS

- Decreases a variety of GI secretions and slows gastric and jejunal transit
- No clear effect on improving nutrient/fluid absorption
  - Short-lasting, expensive, requires injection
  - Increases risk of gallstones
  - May inhibit bowel adaptation
- May be useful in high stool output conditions

*Nehra et al. Am J Gastroenterol 2001*  
*O'Keefe et al. Gastroenterology 1994*

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### Clonidine Use in SBS

- $\alpha_2$ -adrenergic receptor agonist
  - Reduces GI secretions
  - Used to help control diabetic diarrhea
- Recent reports in SBS with high output diarrhea
  - 0.2 mg p.o. BID resulted in ↓ output from ~4L/d to ~1.5L/d in 2 SBS pts
  - 0.3 mg transdermal patch reduced fecal volume by ~427 mL/d with increase in urine volume by ~747 mL/d

*McDoniel et al. JPEN 2004*  
*Buchman et al. JPEN 2006 (abstract)*

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### Antimotility Agents in SBS

- Decrease motility and reduce secretion
  - Loperamide: minimal side effects; OTC
    - 2 to 4 mg ac/hs
  - Diphenoxylate with atropine
    - 2.5 to 5 mg ac/hs
  - Codeine phosphate
    - 30 to 60 mg ac/hs
  - Opium tincture
    - 5 to 20 drops ac/hs
    - (5 drops=0.25 mL=2.5 mg morphine)

*King RFGJ et al. Aust N Z J Surg 1982*

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### Antimicrobial Use in SBS Bacterial Overgrowth

- Multifactorial pathophysiology
- Variety of potential clinical consequences
  - May interfere with PN weaning and predispose to bacterial translocation
  - May be beneficial in CHO salvage
- Unique diagnostic challenge
  - Small bowel aspirate best test (?)
- Antibiotic therapy first line
  - Improved gas-related symptoms, reduction in stool output and/or weight gain

*DiBaise et al. CGH 2006*

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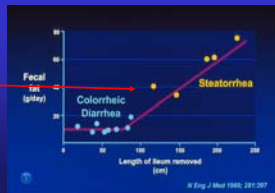
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### Bile Salt and Pancreatic Enzyme Replacement in SBS

- Bile salt depleted when > 100 cm distal ileum resected
- Ox bile supplements and cholylsarcosine
  - Open-label case reports
- Use of bile acid binders (e.g., cholestyramine) to be avoided
  - Worsen fat malabsorption
  - Only use when < 100 cm terminal ileum removed
- No evidence of reduced pancreatic secretion in SBS
- Potential for mismatch of food and enzyme mixing



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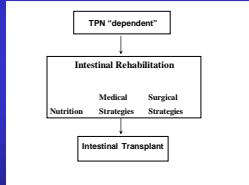
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## Problem with Current Approaches

- PN still frequently necessary
  - Does not enhance bowel function
  - Costly (>\$100K/yr)
  - Reduced quality of life
  - 1–2 hospitalizations annually/patient



Howard et al. *Gastroenterology* 1995  
Tokars et al. *Ann Int Med* 1999  
Cavicchi et al. *Ann Int Med* 2000

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## Risk Factors for Permanent Intestinal Failure

- **Remnant bowel length**
  - ≤ 100 cm end-jejunostomy
  - ≤ 65 cm jejunocolic anastomosis
  - ≤ 30 cm jejunoleocolic anastomosis
- **Residual disease in remnant bowel**
- **Absence of colon**
- **Time on PN**
  - ≥ 2 yrs adults; ≥ 4 yrs children
- Degree to which adaptation has occurred
- Age
- Nutritional status
- Fasting plasma citrulline level < 20 μmol/L
- Wet weight absorption < 1.41 kg/d
- Energy absorption < 84%/d

Messing et al. *Gastroenterology* 1999  
Jeppesen and Mortensen 2003

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## Is there a Role for Enteral Nutrition in SBS?

- Facilitate weaning from PN when oral intake insufficient
  - Gastric, continuous administration
- 61 adults with SBS (50 cm SB) who received EN + PN (+ GH, glutamine, optimized diet) – 50 ± 24 mo f/u
  - EN comprised about 53 ± 13% of total daily calories
  - 52/61 (85%) successfully weaned from PN
  - 5 remained on both PN + EN

Gong JF, et al. *Asia Pac J Clin Nutr* 2009  
DiBaise JK, et al. *JCG* 2006

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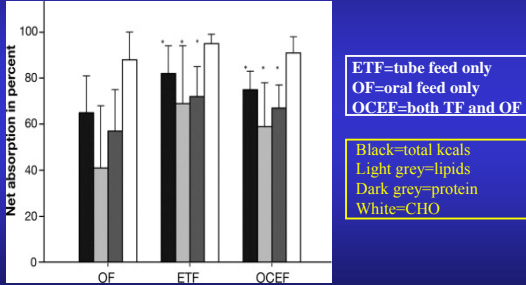
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## Tube Feeding Improves Intestinal Absorption in SBS



Joly F, et al. Gastro 2009

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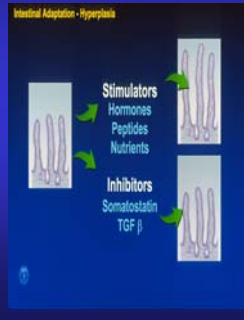
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## Trophic Factors

- Facilitate intestinal adaptation
- Intestinal adaptation**
  - Remaining bowel attempts to increase fluid/nutrient absorption to that occurring before resection
  - Variety of stimulators of adaptation




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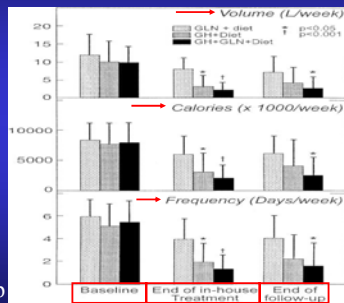
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## RCT of r-hGH, Glutamine and Specialized Oral Diet

- Patients receiving r-hGH + GLN (n=16)
- Patients receiving r-hGH w/o GLN (n=15)
- Controls received GLN + diet (n=9)
- 4 wks treatment w/12 wks follow-up



Byrne et al. Ann Surg 2005

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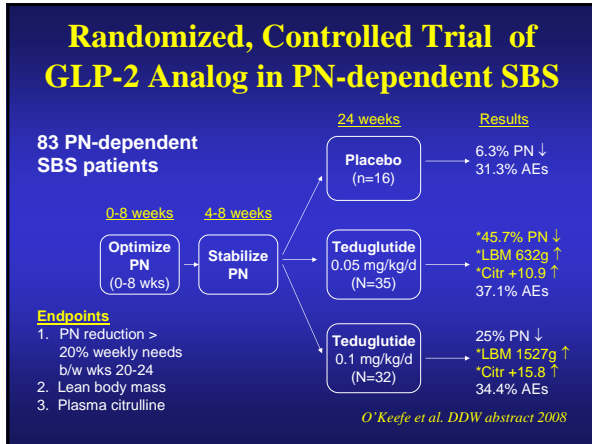
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### Surgery in SBS

- Goal is to preserve as much bowel as possible
  - Restore continuity
  - Relieve obstruction
  - Repair fistulae
  - Recruit bypassed/unused bowel

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### Autologous GI Reconstruction in SBS

- Choice of surgical therapy influenced by
  - Existing bowel length, function and caliber
  - Existing intestinal complications
- Optimize function
  - Increase length (Bianchi, STEP)
  - Taper dilated segment
- Slow transit
  - Reversed intestinal segment

*Thompson JS. Transpl Proc 2006  
Sudan et al. Ann Surg 2007*

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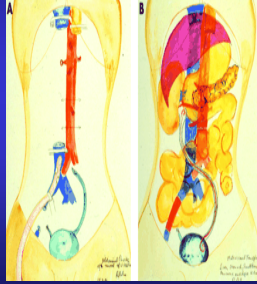
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## Intestinal Transplantation

- **Indications**
  - Irreversible intestinal failure with need for life-long PN and complication of PN
- **Options**
  - Isolated intestinal transplant
  - Combined with liver transplant
  - Multivisceral transplant




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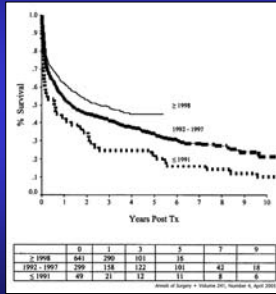
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## Patient and Graft Survival Among Intestinal Transplantation Recipients

- 1-yr graft/patient survival: 58%/65%
- Better since 1998:
  - Graft: up to 65%
  - Patient: up to 77%
- Better in home vs. hospitalized patients:
  - Graft: 70% vs. 51%
  - Patient: 78% vs. 72%




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## Outcome - Home Parenteral Nutrition vs Intestinal Transplant

Short Bowel Syndrome		
	Home parenteral nutrition	Small bowel transplant
1 yr. survival	>90%	80-90%
4 yr. survival	>70%	50-70%
Morbidity	line infection liver disease osteoporosis	rejection GVHD infection lymphoma
Quality of life	>80% good	?
Long-term cost	\$\$\$	\$\$\$

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### Take-Home Points

- Management requires **multidisciplinary** approach
- Specific **dietary** intervention combined with careful **medical** management and occasionally **surgery** represents standard of care
- Utility of **trophic factors** to facilitate PN weaning in SBS remains unclear currently
- Intestinal **transplantation** appears promising

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