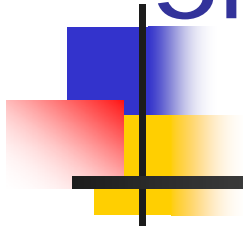


Nutritional Management of Short Bowel Syndrome

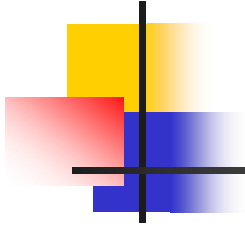


Donald R Duerksen
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University of Manitoba
2015



Case

- A previously well 70 year old woman had surgery for acute mesenteric ischemia. She had a major small bowel resection and ended up with anastamosis of 120 cm of jejunum to colon.

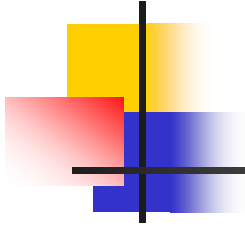


- Should this patient be started on TPN in the post-operative period?



Nutrition Management

- Should this patient be started on TPN?
 - No
 - Currently not malnourished
 - If severely malnourished would start on TPN
 - If well nourished, can wait 7-10 days before starting TPN
 - Important to initiate oral/enteral nutrition as soon as possible to facilitate adaptation



-
- Will this person need long-term TPN?



Nutrition Management

- Will this patient need long-term TPN?
 - Significant variability from patient to patient
 - Dependent on presence of colon
- General Guidelines – TPN needed if
 - End Jejunostomy - < 100cm of jejunum left
 - Functional Colon intact - < 60 cm of jejunum left

EXTENT OF RESECTION

Short Bowel Syndrome



**jejunal
resection**



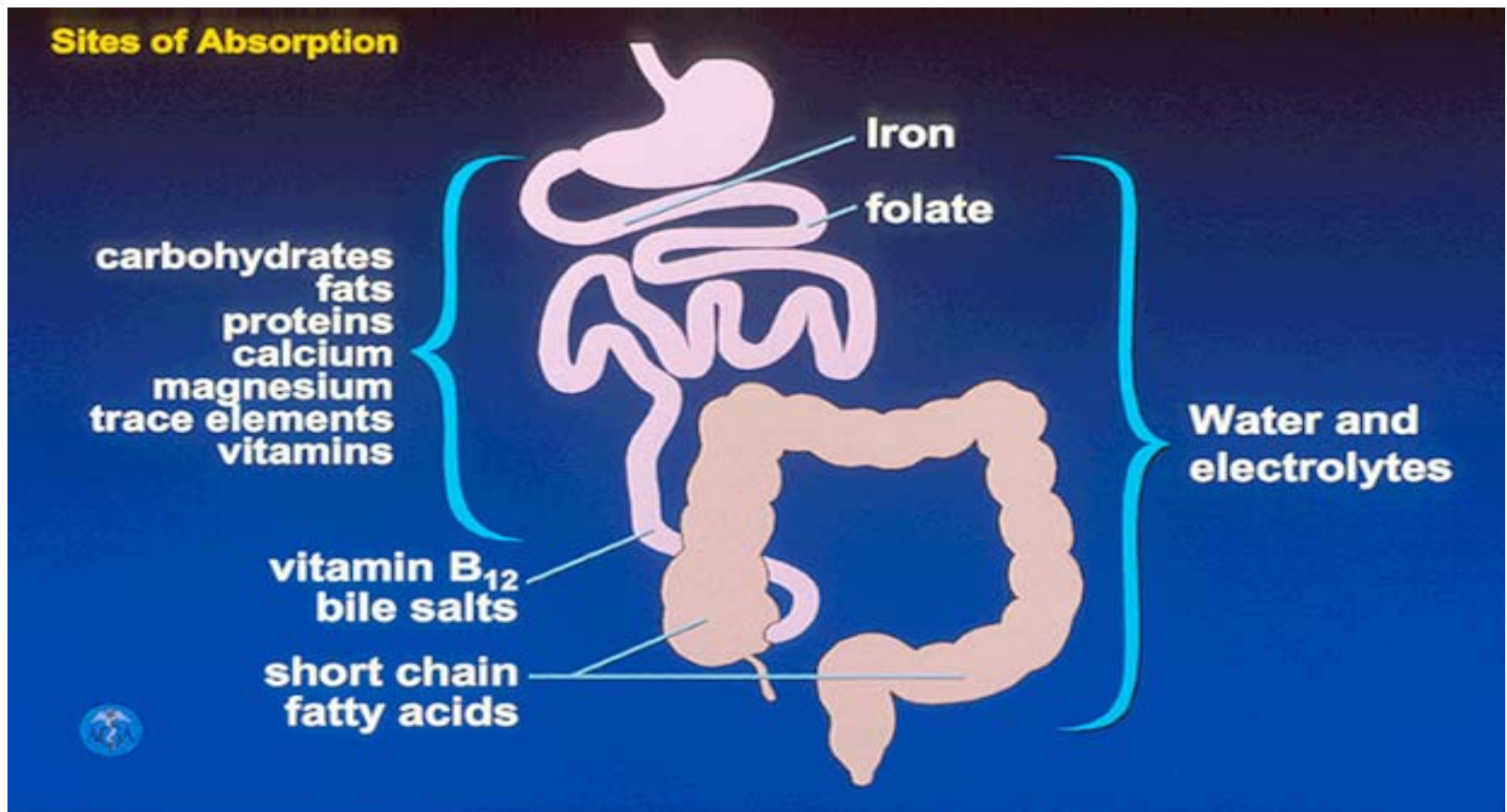
**ileal
resection**



**extensive
resection**



ABSORPTION OF NUTRIENTS





Nutrition Management

When should the GI tract be used?



Nutritional Management

When should the GI tract be used?

- As soon as GIT is functional to promote adaptation.



Intestinal Adaptation

Role of Nutrients

- Fat > CHO + Protein
- FFA > LCT
- Whole protein > AA
- Complex CHO > monosaccharides
- Polymeric > elemental diets



What type of carbohydrate should be recommended?

- Monosaccharides

- glucose
- fructose - fruit
- galactose

- Disaccharides

- lactose - milk
- Sucrose – table sugar (sugar beets, cane)

- Polysaccharides

- starch (amylose, amylopectin) – potato, flour, rice

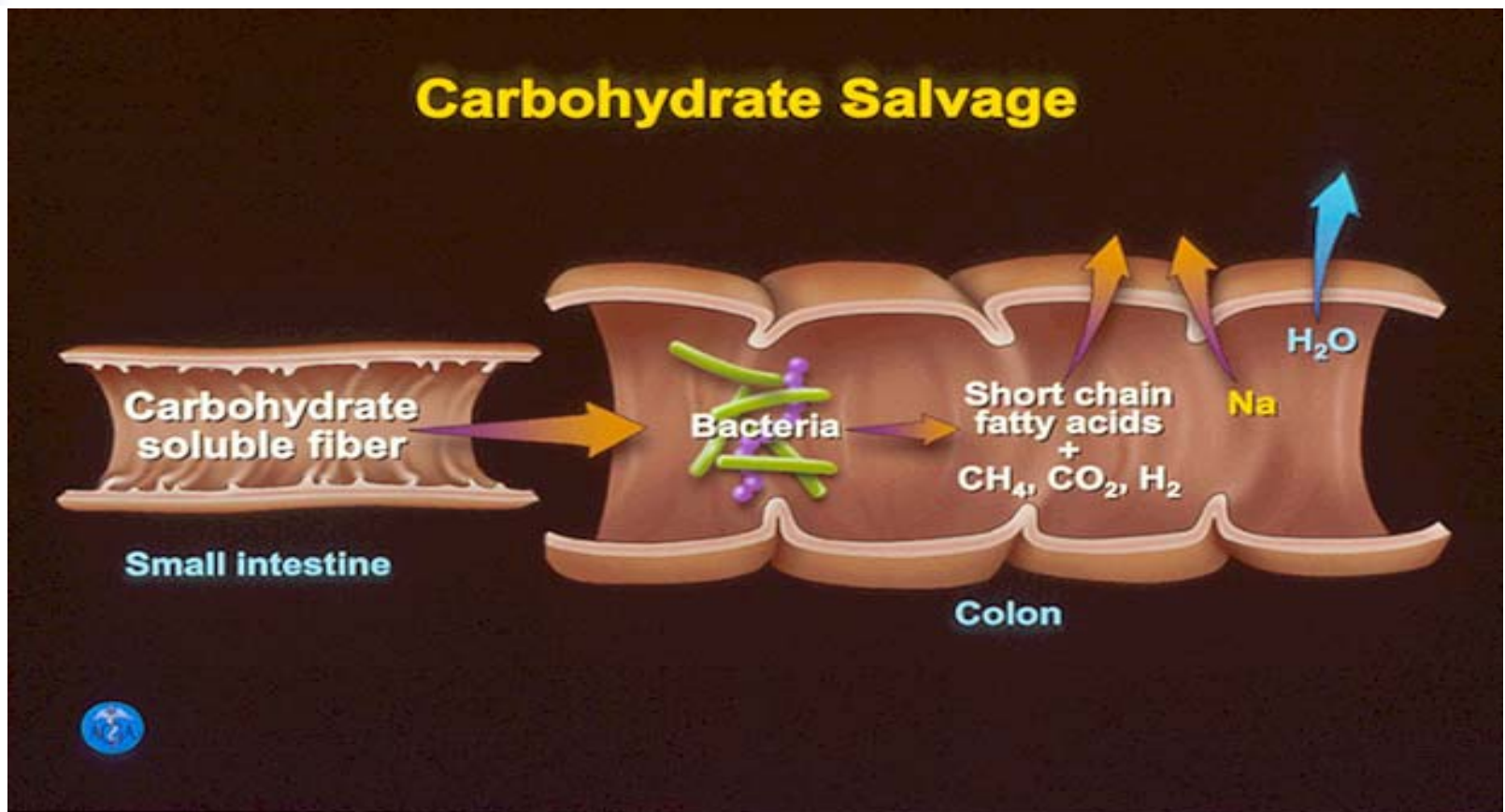


What type of carbohydrate should be consumed?

- Complex carbohydrates are better tolerated due to lower risk of osmotic diarrhea.

No large randomized controlled clinical trials

IMPORTANCE OF COLON





Carbohydrate Salvage

In patients with an intact colon, undigested CHO are metabolized in the colon to short chain fatty acids (acetate, propionate, butyrate).

- SCFAs are absorbed and used as energy substrate
- This may result in salvage of up to 1000 calories per day. Nordgaard AJCN 1996



Carbohydrate Salvage

In patients with an intact colon, undigested CHO are metabolized in the colon to short chain fatty acids (acetate, propionate, butyrate).

- 6 patients – jejunocolic anastomosis
- Malabsorbed 53% N, 50% fat, 32% tot. energy
 - 92% of CHO utilized, Fecal SCFAs increased
- Pectin supplementation 6 g tid
 - Increased SCFA production, greater fluid absorption



Should lactose be restricted in
SBS?



Should lactose be restricted in SBS?

- SBS pts at risk of lactose intolerance due to decreased absorptive area.
 - Lactase - disaccharidase in the brush border of small intestinal villi; Hydrolyzes glucose and galactose; Only monosaccharides absorbed.
 - Could worsen diarrhea due to osmotic effects of unabsorbed lactose.

17 patients with SBS tolerated 20 g lactose (~ 2 glasses of milk) with no increase in breath hydrogen, fluid losses.

Arrigoni AJCN 1994



Diet Management of Short Bowel Syndrome

- What should be recommended regarding fat intake?



Fat Malabsorption in SBS

- Causes

- decreased surface area of intestine
- bile salt wasting

- Effects

- decrease in caloric absorption
- LCFAs cause secretory diarrhea in patients with colon intact
- associated malabsorption fat soluble vitamins



Should fat be restricted?

- In patients with intact colon, consider lower fat and higher complex carbohydrate (60% CHO:20%Fat:20%Protein).
 - Two small studies by Jeejeebhoy in 1980's suggest high fat diet comparable to high CHO diet.
- In patients with end jejunostomy or ileostomy - no restriction of fat necessary



Medium Chain Triglyceride

Advantages

- Absorbed directly across intestinal epithelium without the need for bile salts/lipase.
- Absorbed across colonic mucosa
- Absorbed directly into portal circulation rather than lymphatics.

Disadvantages

- May cause diarrhea
- EFA deficiency



Should MCT be used in SBS?



Should MCT be used in SBS?

A diet enriched in MCT results in increased fat absorption in patients with an intact colon.

- Randomized crossover study CHO:pro:fat 20:24:56
LCT vs LCT/MCT (50/50)
19 patients (9 jejunostomy, 10 colon)
patients with colon increased fat absorption from 23% to 58%



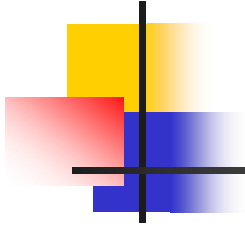
Protein

- What would be your protein intake recommendations for this patient?



Protein

- Short Bowel Syndrome
 - Absorption of protein least affected by decreased intestinal length
 - Theoretically small peptides preferentially absorbed in small bowel.
 - Little data to support this
 - McIntyre et al 1986 – no benefit (7 patients)
 - Cosnes et al 1992 – improved protein absorption (6 patients)
 - Reasonable to provide whole protein
 - Increase to 1.2-1.5 g/kg

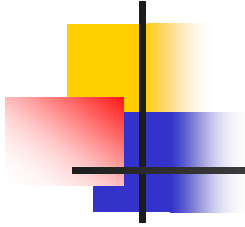


-
- What is the relevance of having colon in continuity in short bowel syndrome?



Relevance of Colon

- Beneficial Physiology
 - Improved water absorption
 - Increase capacity 4-5x
 - Tight junctions of colon
 - SCFA production
 - Energy source
 - Enhance absorption
 - Absorb MCT
 - Increase Peptide YY release
 - Decrease motility, delay gastric emptying
 - Increase GLP-2 release
- Complications
 - Oxalate absorption
 - D Lactic Acidosis
 - Bacterial overgrowth
 - Secretory diarrhea due to LCT



-
- What about tube feeding in short bowel syndrome?



Elemental Formulas

- Defined formula diets (elemental diets) are not better absorbed than a solid diet and therefore their role in SBS is limited.

McIntyre Gastroenterology 1986



Tube Feeding in Short Bowel Syndrome

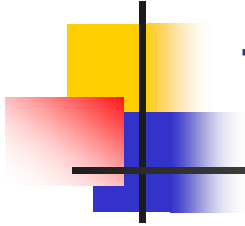
- 15 patients with short bowel syndrome
 - Median 7.5 months after surgery
 - Randomized, crossover study
 - Diet vs tube feeding (polymeric – 20:30:50)
 - 7 day study, 7 day washout, 7 day study
 - 11/15 patients had colon present
 - Jejunal length 25-130 cm
 - Joly Gastro 2009;136:824-831



Tube Feeding in Short Bowel Syndrome

- Results (tube feeding vs oral)
 - Protein absorption – 72% vs 57%
 - Lipid absorption – 69% vs 41%
 - Energy absorption – 82% vs 65%
- ? Role of tube feeding in maintaining short bowel syndrome

New Pharmacologic Therapies for SBS





GLP-2 Analogue

- Multicenter randomized controlled trial
 - 86 patients 0.05 mg/kg sc vs placebo
 - 0.05mg/kg reduced PN requirements by at least 20% - 63% vs 30%
 - Decreased TPN/wk 4.4L vs 2.3L
 - Decrease at least 1 day TPN/Wk 54%vs 23%
 - Increased villous height
 - Increased plasma citrulline (intestinal mass)
- Jeppesen et al Gastro 2012



What complications are associated with SBS?

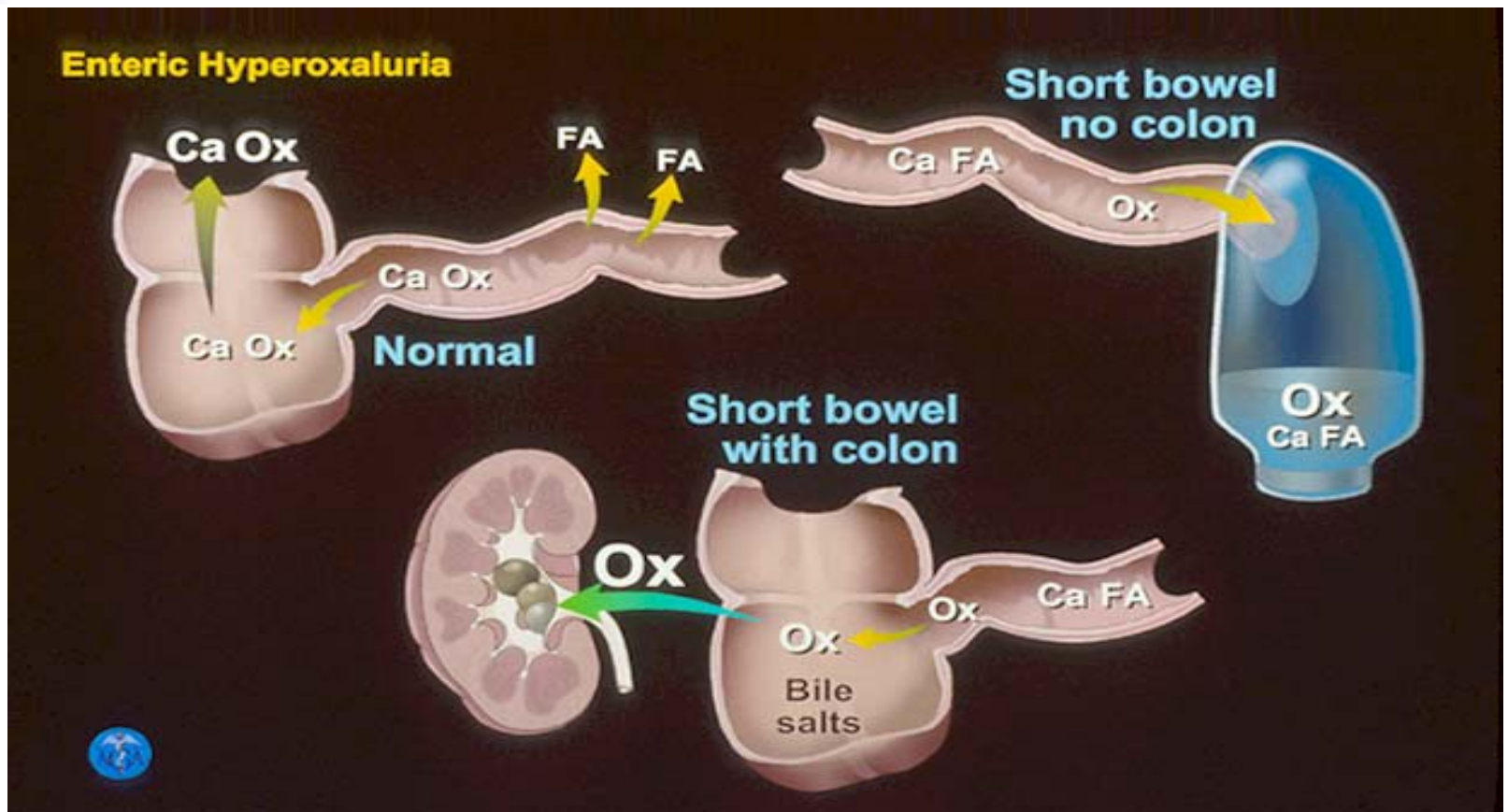
- Oxalate nephropathy
- D- lactic acidosis



Oxalate Nephropathy

- Normally oxalate combines with calcium to produce insoluble, non-absorbable calcium oxalate.
- Malabsorbed LCFA bind calcium leaving free oxalate to be absorbed in the colon.
- Malabsorbed bile salts may increase colonic permeability, enhancing absorption of oxalate.

OXALATE NEPHROPATHY





Oxalate Nephropathy

- Diagnosis of hyperoxaluria
 - 24 hour urinary oxalate
- Rx: Low oxalate diet, low fat diet, calcium supplementation, ?bile acid binding resins



D-Lactic Acidosis

- D-lactic acidosis first described in 1979
- CHO fermented by bacteria
 - Lower pH in colon
 - Promotes growth of acid resistant anaerobes
 - More likely to produce D lactate
- No metabolic pathway for D-lactate
 - Lack D- lactate dehydrogenase
- Excreted by kidneys



D-Lactic Acidosis

- D-lactate not normally measured by labs
 - Special request needed
- clinical symptoms: dizziness, ataxia, dysarthria, visual disturbances, confusion, headache, drowsiness, weakness, behavioral changes
- Rx: ab, decrease CHO (simple), ? probiotics

Nutrition and Hydration in SBS

Maitreyi Raman MD FRCPC

Clinical Associate Professor

University of Calgary

Don Duerksen MD FRCPC

Associate Professor

University of Manitoba

Conflict Interest

- Donald Duerksen
 - No conflict of interest to declare
- Maitreyi Raman
 - No conflict of interest to declare

Objectives

A case based presentation will be utilized for this session.

At the end of this session, the participants will be able to:

- describe the pathophysiology of dehydration, hypomagnesemia, and malnutrition in short bowel syndrome
- manage high ostomy output related to short bowel syndrome.
- recommend appropriate nutritional and hydration management strategies for patients with short bowel syndrome



CanMEDS Roles Covered in this Session:

✓	<p>Medical Expert (as <i>Medical Experts</i>, physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional attitudes in their provision of patient-centered care. <i>Medical Expert</i> is the central physician Role in the CanMEDS framework.)</p>
	<p>Communicator (as <i>Communicators</i>, physicians effectively facilitate the doctor-patient relationship and the dynamic exchanges that occur before, during, and after the medical encounter.)</p>
	<p>Collaborator (as <i>Collaborators</i>, physicians effectively work within a healthcare team to achieve optimal patient care.)</p>
	<p>Manager (as <i>Managers</i>, physicians are integral participants in healthcare organizations, organizing sustainable practices, making decisions about allocating resources, and contributing to the effectiveness of the healthcare system.)</p>
	<p>Health Advocate (as <i>Health Advocates</i>, physicians responsibly use their expertise and influence to advance the health and well-being of individual patients, communities, and populations.)</p>
✓	<p>Scholar (as <i>Scholars</i>, physicians demonstrate a lifelong commitment to reflective learning, as well as the creation, dissemination, application and translation of medical knowledge.)</p>
	<p>Professional (as <i>Professionals</i>, physicians are committed to the health and well-being of individuals and society through ethical practice, profession-led regulation, and high personal standards of behaviour.)</p>

CASE

- 48 year old male
 - SB ischemia secondary to mesenteric thrombosis
 - 6 months post-op
 - Jejunostomy
 - Defunctioned colon
 - 3 L of ostomy output daily
 - Thirsty, weak, 100/60
- Labs
 - CBC – N
 - Na- 132
 - K – 3.7
 - Cl – 95
 - BUN-12
 - Creatinine - 115
 - Mg-0.58
 - PO4 0.8
 - Albumin - 34

Thoughts?

**WHAT OTHER HISTORY WOULD YOU
LIKE TO KNOW?**

Course of Events

- 140 cm of Jejunum left ending in ostomy
- Normal bowel mucosa
- Thirsty
- Drinks 4L of water daily
- Uses Imodium with minimal effect
- No other GI symptoms
- **What would you do next?**

Intestinal Failure

- Global term
 - Obstruction/PSBO
 - Dysmotility
 - Surgical resection
 - Loss of absorption
- SBS is one of the most common forms of intestinal failure
 - Average length of SB – 635 cm
 - Bowel equipped with large functional reserve
 - Compensate for resections \leq 50% of bowel length

Management of SBS - Goals

- Directed toward minimizing GI symptoms
- Maximizing absorptive capacity
 - Maintaining fluid
 - Electrolyte
 - Nutrient balance
- Treatment options
 - Dietary
 - Medical
 - Surgical

Normal GI Physiology

	Liquid	Vol secreted (L)	Vol absorbed(L)
External	Food & drink	2	
Salivary glands	Saliva	0.5-1	
Stomach	Gastric juice	2-3	
Pancreas	Pancreatic juice	0.5-0.8	
Liver	Bile	0.5-0.9	
Jejunum	Passive proximal secretion & distal absorption	1-2	1-2
Ileum	Active absorption		2-5, vit B12, bile salts
Colon			Large capacity
External	Feces	400	
Total		6.5-9.7	3-9

Gastrointestinal Motility

Jejunal-colon:
NORMAL

Jejunostomy:
FAST

Peptide YY and GLP-2 are released when food passes the terminal ileum and cecum that act as ileal and colonic braking mechanisms; this is lost in jejunostomy

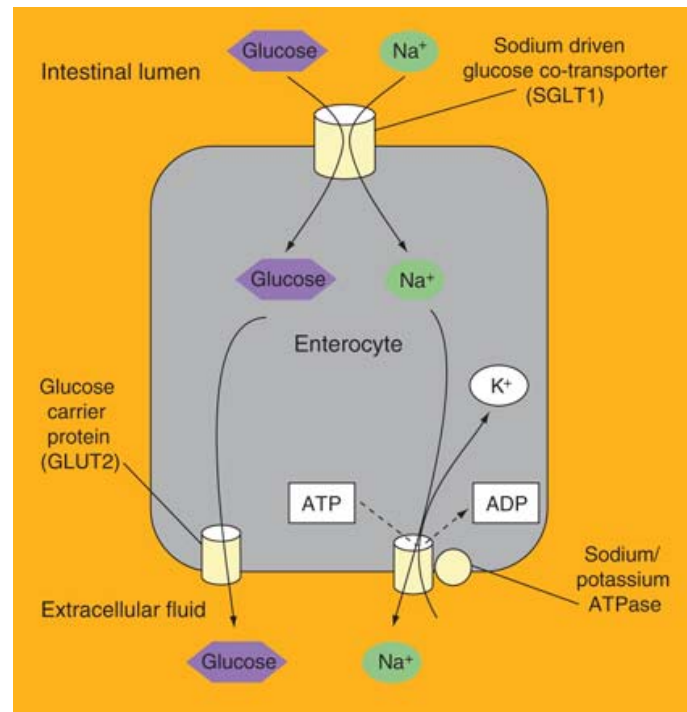
Physiological Consequences

- Increased gastric emptying
- Increased SB transit
- Increased gastric secretions (first 2 wks)
- Inadequate mixing – bile / pancreatic enzymes
- Resection of ileal & colonic braking mechanism
- Changes in GI hormones
 - Reduced peptide YY, glucagon like peptide 2
 - Increased gastrin

Do you use Oral
Rehydrating Solution?
Which one?

Mechanism ORS

- Jejunal glucose-sodium co-transport
- Energy dependent process
- Enhanced water absorption
- Expansion of extracellular fluid



Composition of commercial oral rehydration solutions and commonly consumed beverages

ORS	CHO (g/L)	Na (mmol/L)	K (mmol/L)	Cl (mmol/L)	Osmolarity (mosM/L)
WHO (2002)	13.5	75	20	65	245
Pedialyte	25	45	20	35	250
Ceralyte	40	50-90	20	NA	220
Apple Juice	120	0.4	44	45	730
Coca-Cola	112	1.6	NA	NA	650
Gatorade	58.3	20	3.2	11	299

Atia et al. Am J Gastro
2009;104(10):2596-604.

Summary of rice-based ORS in non-cholera diarrhea

Intervention	Compared Solution	Trial	Patients	Stool Volume	Duration of diarrhea
Rice-based ORS containing 50g/L rice powder	WHO	Iyngkaran et al. (1998)	63 Infants < 6 months of age and acute diarrhea	Decreased	Decreased
Rice based ORS 30 g/L rice powder	WHO	Molla et al (1985)	124 patients with acute infectious diarrhea	No sig difference	Not documented
Rice based ORS 80g/L	WHO	Molla et al. (1985)	342 patients, half adults, acute diarrhea	Decreased	Not documented
Rice based ORS	WHO	Gore et al. (1992) Meta-analysis 13 clinical trials	1,367 patients with acute infectious diarrhea	Decreased	Decreased

Oral Rehydrating Solution

- U.S ORS is underused in adults with diarrhea
 - Overestimation of the degree of dehydration
 - Misbelief that moderate or severe dehydration ubiquitously warrant IVF
 - Mistake belief that ORS is more labour intensive and more expensive
- Systematic review of 17 clinical trials found no significant difference between ORS vs. IVF for dehydration secondary to acute infectious diarrhea in children

PN and IV Fluid Optimization

- Prescribed dosage of ORS depends on degree of dehydration
 - Mild (3-5% body weight loss) 50 mL/kg over 2-4 hours
 - Moderate dehydration (6-9% weight loss) 100mL/kg
 - Severe dehydration (>10%) IVF initial replacement
 - Ongoing fluid losses replaced

Establish Oral Intake

- Restrict hypertonic/hypotonic Fluids
 - Hypotonic (water, tea, coffee, alcohol)
 - Hypertonic (fruit juices, coca cola, sip feeds)
- Drink an ORS solution for all additional fluids

**How often do you see
hypomagnesemia in the setting of
bowel resections?**

How do you typically manage this?

Hypomagnesemia and SBS

- Magnesium is unique among the minerals as it is absorbed in the distal SB and colon
- Large distal resection result in hypomagnesemia
- Mg depletion occurs in setting of fat malabsorption because the divalent cation binds to fatty acids in intestinal lumen and excreted in stool

Hypomagnesemia Treatment

- Oral repletion if available and tolerable
 - Minimal or no symptoms
 - Worsening diarrhea
- Sustained release preparations slowly absorbed
 - Minimize renal excretion
 - May permit lower doses
 - Minimize diarrhea
 - Magnesium Chloride (64-72 mg elemental Mg)
 - Slow-Mag / Mag-Tab SR
 - 6-8 tabs divided doses for moderate severe Mg depletion

Hypomagnesemia Treatment

- Mg Oxide (800-1600mg daily dose)
 - Frequent diarrhea side effect
- IV Mg replacement
 - Day Medicine

Regarding slowing down ostomy outputs, if codeine and imodium aren't effective, what other therapies could you try?

Drug Therapy

Antimotility:

- Loperamide 2-6 mg qid
- Codeine (15-90mg qid)
- Lomotil (2.5-5mg qid)

Malabsorption:

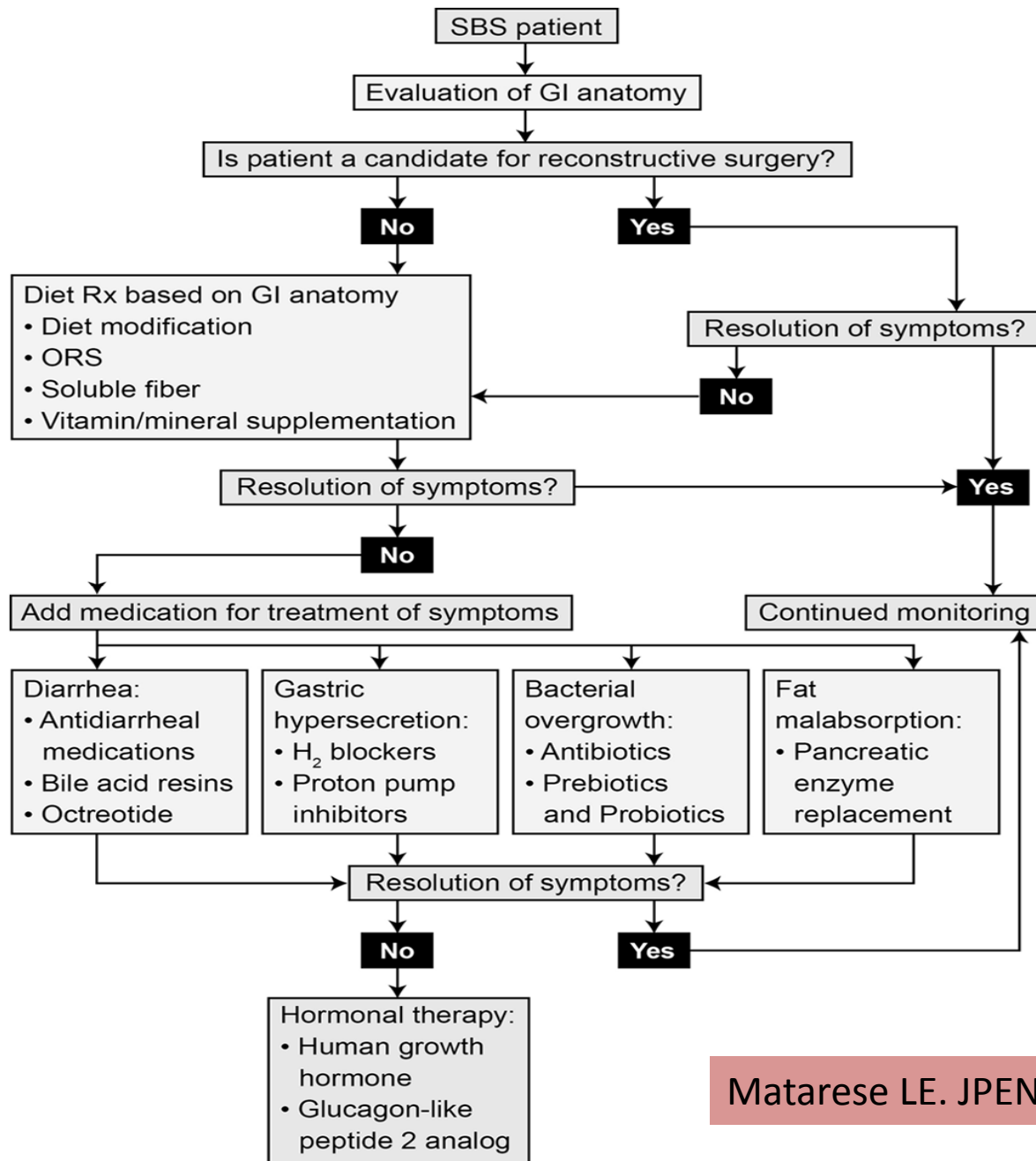
- Pancreatic Enzymes
- Rx SBBOG

Antisecretory:

- Omeprazole; decreases gastric acid secretion
- Ranitidine/cimetidine
- Octreotide; decreases intestinal secretions
- Clonidine (0.1-0.3mg tid)

Outcome Aims

- **Clinical:**
 - No thirst or signs of dehydration
 - Acceptable strength, energy and appearance
 - Acceptable labs
- **Measures:**
 - Gut loss **<2L/day**
 - Urine volume **>800ml/day**
 - Urinary Na⁺ **>20 mmol/L**
 - Normal serum Na⁺, Mg²⁺ and K⁺
 - Body weight within **10%** of normal



Matarese LE. JPEN 2013;37(2):161-170.