Minimizing (& Understanding) Diarrhea

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Conflict of Interest Statement

Commercial Interests
None

Off Label Usage
None
Learning Objectives

At the end of this session the participant will be able to:

* List potential causes of diarrhea in typical consumers of HPEN
* Describe the science of these diarrheal illnesses
* Identify ways to avoid diarrhea by altering dietary habits
* Discuss potential treatments for diarrhea
NORMAL GASTROINTESTINAL ANATOMY

- Mouth
- Esophagus
- Small Intestine ~400 cm* (reported range 10-20 feet)
  • Duodenum 25-30 cm
    - Bile duct
    - Pancreatic duct
  • Jejunum 160-200 cm
  • Ileum 170-215 cm
    - Ileocecal valve
- Large intestine ~150 cm (aka colon)
  • Anus

* 2.54 cm = 1 inch (or 1 cm = 0.39 inch)
WOW!!!!
Small Intestinal Structure

An ever increasing surface area!

2,000,000 square centimeters

Valvulae Conniventes
X 3

Villi
X 30

Microvilli
X 600
Know YOUR Altered Anatomy

What, if anything, has been removed?
-- Duodenum / Jejunum vs. Ileum
  * Ileum only segment capable of actively absorbing bile salts and vitamin B12; D / J resection better as ileum takes over
-- Colon - aggressively absorbs water

How much remains?
-- More than 100 cm (1 meter = 39.37 “) best

How does the rest work?
-- Stomach intact helps control gastric emptying
-- Colon helpful with absorption as well
Short Bowel Syndrome (Adults)

-- Medicare definition:
  < 5 feet remaining
-- Practically: if 100 cm healthy small bowel remains and no colon in place, often able to do well without TPN
-- If >60 cm healthy small bowel & colon in place, often able to do well without TPN
-- If shortened small bowel but active disease, virtually any length may require TPN and for some possibly IV fluids also
Increased length, diameter and villous height

Increasing ability to absorb starting right after resection, most rapid after about 3 months, continues ~2 years

Frequently after adaptation has occurred maximally, TPN/HPN may be able to be weaned or at least decreased.
Intestinal Adaptation

Removal of intestine ~ 1-2 yr to taller villi and better absorption

Normal villi

Nothing By Mouth

“Super” villi

Atrophied villi
Osmosis

Q: Will water flow left to right or right to left?
Osmosis and Fluid Balance

= Diarrhea

= Dehydration

Sugar

Contents of Small Bowel

Intestinal Wall

Blood
Osmolality of Blood ~300 mOsm

Keep fluids ingested below 300 to favor absorption
The Effect of Osmolarity

Normal Osmolarity of Blood

285 - 300 mOsm / liter

S O W H A T ? ? ? ?

Fluids outside 235 to 350 mOsm/L cause fluid loss from the intestine when they are ingested (result: DIARRHEA).
# Osmolality of Various Beverages

<table>
<thead>
<tr>
<th>Beverage</th>
<th>mOsm/liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prune juice</td>
<td>1265</td>
</tr>
<tr>
<td>Hi-C orange</td>
<td>809</td>
</tr>
<tr>
<td>Orange juice</td>
<td>614</td>
</tr>
<tr>
<td>Kool-aid + 1 cup sugar</td>
<td>448</td>
</tr>
<tr>
<td>Carbonated beverages</td>
<td>&gt; 700</td>
</tr>
</tbody>
</table>
Where sodium goes, water follows!
(aka Co-transport)
World Health Organization
Reduced Osmolarity Oral Rehydration Solution (ORS)

sodium chloride (table salt) 1/2 teaspoon
potassium chloride (Salt Substitute) 1/4 teaspoon
sodium bicarbonate (baking soda) 1/2 teaspoon
(or odor/ tasteless Tricitrate sodium)
sucrose (table sugar) 2 Tablespoons
tap water to make one liter

Sugar-free beverage mix (Kool-aid®, CrystaLyte® etc.) to taste
Left-over ORS should be discarded or frozen at 24 hrs
On the Flip Side: What about Water?

Osmolality is close to zero.........intestine must absorb it like a sponge..........right?

WRONG!!! In short bowel (esp. without colon) water is a poor hydrator. More fluid is lost than is drunk!

WHY?? NO sodium in water, high sodium in blood, sodium moves downhill and takes water with it!
Are Sugar Substitutes Always OK: The Chewing Gum Diarrhea Mystery

• Some sleuthing revealed that the culprit was sorbitol (an alcohol based sweetener that is not absorbed in human gut).

• The result is diarrhea based on osmotic load! Check the labels...
Colon Intact... What then?

-- If a small amount of ileum is removed, some bile is malabsorbed (but replaced by liver) and in the colon, bacterial action on bile causes water secretion. Rx – bind bile

-- If a large amount of ileum is removed, bile is depleted (liver can’t keep up) so bile pool is decreased resulting in poor fat absorption. Bacterial action in the colon changes fat to a castor oil-like substance (for the youth GoLytely forerunner)!
Bacterial overgrowth syndrome, but for a different reason!

-- With normal motility, like a smoothly flowing river, the intestinal contents are fairly clear.

-- In situations where intestinal contents move slowly through the gut, bacteria increase in numbers. It’s analogous to backwaters of a river (“buggy”)!
Drugs to Decrease Diarrhea

Anti-diarrheals – slow intestinal motility
Loperamide, diphenoxylate, opium tincture

Hints to get optimal results:
Timing – 15-30 minutes before eating and bedtime
Crushing – improves absorption
Adjust dosage gradually until effective or side-effects
Others include narcotic medications

BUT

Concerning side-effects, including addiction and mental blunting, tolerance, interaction with other medications.
Controlling diarrhea in various intestinal situations may require:

- Limiting sweets, high osmolarity drinks
- Avoiding free water, coffee, tea, diet pop
- Limiting fats
- Treating bacterial overgrowth syndrome

It all depends on your anatomy and gastrointestinal function