Nutrition and Inflammatory Bowel Disease

- Overview: nutritional challenges in IBD
- Can a bad diet cause IBD?
- Doctor What Can I Eat?
  - Fiber: Why you need it, how to get enough
  - Good verse bad fats
  - Specific nutrients: Calcium, iron, B12, Zinc, antioxidants.
  - Miracle diets
  - Nutrition in a can? Role of nutritional supplements
How the Normal Gut Functions Nutritionally: An Overview:

Liver/Pancreas: makes enzymes
Helps digest fat and proteins

Small intestine:
Carbohydrate digestion
Absorption of all nutrients:

Duodenum:
Iron absorption

Terminal Ileum:
B12 absorption

Stomach:
Churns food,
Breaks down into smaller nutrients.

Large intestine:
Water absorption
Nutrients: up to 400 cal/day
Inflammatory Bowel Disease

- Estimated 1-2 million people in U.S.
- Ulcerative Colitis
  - Limited to large intestine
- Crohn’s Disease
  - Anywhere in Gastrointestinal Tract
# Nutritional Issues in Gastrointestinal Disease

<table>
<thead>
<tr>
<th>Causes of Malnutrition in Gastrointestinal Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Dietary Intake</td>
</tr>
<tr>
<td>Increased Nutrient Loss</td>
</tr>
<tr>
<td>Increased Metabolism</td>
</tr>
<tr>
<td>Malabsorption</td>
</tr>
<tr>
<td>Maldigestion</td>
</tr>
<tr>
<td>Surgery</td>
</tr>
</tbody>
</table>
Inflammatory Bowel Disease

Malabsorption is a major contributor to malnutrition in Crohn’s Disease.

Patients with CD in remission
Assessed calories lost in stool

Vaisman et al, Nutrition 2006
Body Composition Status in Inflammatory Bowel Disease

- Crohn’s Disease
  - Decrease Lean Body Mass
  - Decreased Muscle Function
  - Weight loss common
- Ulcerative Colitis
  - Decreased body mass body weight at time of diagnosis
  - Normal in population based studies

Jahnsen et al, Am J Gastro 2003
Inflammatory Bowel Disease
Growth and Development

- Growth Failure
  - 15-40% of Children
  - May precede diagnosis
  - 30% diagnosed as children <5 percentile for height as adult

- Mechanism:
  - Decreased intake
  - Malabsorption
  - Effect of inflammatory cytokines

- Treatment
  - Enteral/elemental nutrition
  - Growth Hormone
  - Aggressive Therapy: Anti:TNF

Shamir et al, Inflamm Bowel Disease, 2000
Hyams et al, Gastroenterology 2007
# Inflammatory Bowel Disease

## Nutritional Status

**Table 2. Frequency of nutritional deficiencies in inflammatory bowel disease.**

<table>
<thead>
<tr>
<th>Nutritional problems</th>
<th>Estimated frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CD</td>
</tr>
<tr>
<td>Weight loss</td>
<td>65–75</td>
</tr>
<tr>
<td>Hypoalbuminaemia</td>
<td>25–80</td>
</tr>
<tr>
<td>Anaemia related</td>
<td></td>
</tr>
<tr>
<td>Anaemia</td>
<td>60–80</td>
</tr>
<tr>
<td>Iron deficiency</td>
<td>39</td>
</tr>
<tr>
<td>Vitamin B₁₂ deficiency</td>
<td>48</td>
</tr>
<tr>
<td>Folic acid deficiency</td>
<td>54</td>
</tr>
<tr>
<td>Bone related</td>
<td></td>
</tr>
<tr>
<td>Calcium deficiency</td>
<td>13</td>
</tr>
<tr>
<td>Vitamin D deficiency</td>
<td>75</td>
</tr>
<tr>
<td>Magnesium deficiency</td>
<td>14–33</td>
</tr>
<tr>
<td>Vitamin K deficiency</td>
<td>+</td>
</tr>
</tbody>
</table>

O’Sullivan and Morain Best Practice and Clinical Research Clinical Gastroenterology, 2006  
Vagianos et al, JPEN 2007
Inflammatory Bowel Disease

Body Composition

Crohn’s and fat?

In a patient with mildly active Crohn's disease on immunosuppressive medication:

<table>
<thead>
<tr>
<th></th>
<th>CD Patients (n=76)</th>
<th>Controls (n=80)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>24.7</td>
<td>26.8</td>
<td>0.01</td>
</tr>
<tr>
<td>Underweight</td>
<td>2.6% (2)</td>
<td>1.2% (1)</td>
<td></td>
</tr>
<tr>
<td>Normal Weight</td>
<td>57% (43)</td>
<td>41% (33)</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>32% (24)</td>
<td>34% (27)</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>8% (6)</td>
<td>23.8 (19)</td>
<td></td>
</tr>
<tr>
<td>Energy Intake</td>
<td>2225 +/- 693</td>
<td>2932 +/- 993</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sedentary</td>
<td>59% (45)</td>
<td>33.8 (27)</td>
<td>0.003</td>
</tr>
<tr>
<td>Active</td>
<td>41% (31)</td>
<td>66.2% (52)</td>
<td></td>
</tr>
</tbody>
</table>

Guerreiro, Am J Gastro 2007
Inflammatory Bowel Disease

- Role of Nutrition?
- Etiology
- Deficiency States
- Therapy
Inflammatory Bowel Disease: Etiology

- **Hygiene Hypothesis**: lack of immune tolerance.
- **Dietary Risk**: more refined sugars, increased fats:
  - Potentiate inflammatory cascade
  - Lower antioxidants
**Inflammatory Bowel Disease: Etiology**

Epidemiologic Survey Manitoba, Canada

Compared diet and lifestyles in Patients with Crohn’s (n=364), UC (n=217) vs. controls (n=433)

Less likely to have drank unpastuerized milk have eaten pork or. Odds ratio =2.48.

Bernstein Am J Gastro, 2006
**Inflammatory Bowel Disease: Etiology**

In Japan, the incidence of IBD is rising parallel to an increase in the Western diet. In Japan, Crohn’s and UC are associated with higher intakes of refined sugar and fat.

Higher intakes of red meat are associated with increased frequency of relapse.

That’s nice Doctor:
So what do I eat?

- Avoid high fats, overly refined foods, chemical additives, excess sugars
- Red meat infrequently
- Know what fiber you can tolerate
- Know what fats are helpful
- Get enough vitamins.
Fiber: Why you need it:

Diversion Colitis: A colon deprived of nutrients for too long can become inflamed.

Fiber is the source of short chain fatty acids (SCFA) and is a major source of nutrients for the gut.
Fiber Different Types

- **Fermentable fiber**: digested by bacteria in your gut: source of short chain fatty acids.
- **Insoluble Fiber**: not dissolved in water, increases stool bulk and frequency of bowel movements:
  - Good sources: Green leafy vegetables, whole grains, whole fruits.
- **Soluble Fiber**: dissolves in water, thickens stool, decreases frequency of bowel movements: gums, pectins.
  - Good Sources: gums, pectins (apples, bananas), oatmeal, psyllium (metamucil)
When your well:  
*Eat as much fiber as you can.*

Short Chain Fatty Acids: Enriched Soluble Fiber

Germinated Barley Foodstuff  
Rich in hemicellulose  
Previously shown to increase SCFA in UC patients

59 patients with UC in remission  
Randomized to 20gm GBF vs. control

When Fiber is Problematic:

- When you have active inflammation:
  - Increased stool bulk will increase cramps and diarrhea.

- When you have a narrowing or stricture:
  - Increase chance of blockage

- Increase soluble fibers or “soft fibers”
Good sources of soft fiber:

- Oatmeal
- Peeled fruits, removed stringy material from citrus,
- “Soft vegetables” potatoes, squash
- Guar gum, Psyllium dilute well: lots of water
- Small servings of well cooked vegetables.
Understanding Fats

Triglycerides

Saturated/Unsaturated Fats

Fatty Acids

C - Fatty acid 1
L
C - Fatty acid 2
L
C - Fatty acid 3

Schematic Diagrams of Fatty Acid Structures

- Stearic Acid: A typical saturated fatty acid
  - c18:0

- Oleic Acid: A typical mono-unsaturated (omega-9)
  - fatty acid - c18:1w9

- Linoleic Acid: An omega 6 poly-unsaturated fatty acid
  - c18:2w6

- Linolenic Acid: An omega 3 poly-unsaturated fatty acid
  - c18:3w3
Inflammatory Bowel Disease

Etiology Good versus Bad fats?

<table>
<thead>
<tr>
<th></th>
<th>Danes</th>
<th>Greenlanders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Disease</td>
<td>xxxxx</td>
<td>x</td>
</tr>
<tr>
<td>Cancer</td>
<td>xxxxx</td>
<td>XXX</td>
</tr>
<tr>
<td>IBD</td>
<td>XXXX</td>
<td>None</td>
</tr>
<tr>
<td>Fat calories%</td>
<td>42</td>
<td>39</td>
</tr>
<tr>
<td>Ratio: PUF TO SF*</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Ratio: Omega 3 to 6</td>
<td>0.3</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* PUF: polyunsaturated fat, SF: saturated fat

J. Scala: Eating Right for a Bad Gut
Inflammatory Bowel Disease

Etiology

Good versus bad fats?

Omega-6 → thromboxanes → leukotrienes → inflammation

Omega-3 → prostaglandins → leukotrienes → inflammation

Foods Rich in Omega 3
Flaxseed Oil
Fish Oil: Salmon, Tuna,
Inflammatory Bowel Disease: Therapeutic Nutrition: Supplements

Role of omega-3 (fish oil) in maintaining remission in Crohn’s disease

<table>
<thead>
<tr>
<th>Study</th>
<th># Subjects</th>
<th>Dosage</th>
<th>Drug</th>
<th>Placebo</th>
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</thead>
<tbody>
<tr>
<td>Belluzi 1996</td>
<td>78 Adults</td>
<td>2.7gm</td>
<td>28%</td>
<td>69%</td>
</tr>
<tr>
<td>Lorenzo-Meyer 1996</td>
<td>135 Adults</td>
<td>5.1gm</td>
<td>57%</td>
<td>55%</td>
</tr>
<tr>
<td>Belluzi 1997</td>
<td>50 Adults (s/p ileal resection)</td>
<td>2.7gm</td>
<td>8%</td>
<td>21%</td>
</tr>
<tr>
<td>Romano 2005</td>
<td>38 Children</td>
<td>1.8gm</td>
<td>61%</td>
<td>95%</td>
</tr>
</tbody>
</table>

Chronic Disease of Systemic Reviews, 2007

Relapse at one year
**Inflammatory Bowel Disease**

**Osteoporosis**

- **15% of IBD patients**
  - 11% diagnosed under age of 40
  - Hip Fracture increased 40% over general population
    - $rr=1.68$ Crohn's, $1.41$ UC
  - Risk factors Steroids, other meds (CSA, MTX), $\downarrow$ Vitamin D

- **Screening** - consider everyone at initial diagnosis

- **Treatment**
  - Vitamin D 800iu, Calcium 1500mg
  - Lower threshold for biphosphonate treatment,
    - $z$-1.0 to -1.5

Bernstein et al, Gastroenterology 2003
Lichenstein et al, Inflam Bowel Disease, 2006
Getting Enough Calcium in Your Diet

- **Dairy:** milk, cheese, yogurt
  - Choose low fat sources
  - Lactose free

- **Sardines**

- **Spinach, Broccoli**
  - Generally not good source,
  - may be hard to tolerate

- **Fortified foods**
  - Orange juice, cereals, rice milk, soy products

- **Supplements**
  - Many come with Magnesium and Vitamin D
Iron Deficiency

- Iron deficiency
  - Typically you need only 10-20mg day
  - Excessive blood loss
  - Although the part of the small intestine that absorbs iron is very rarely involved many patients have a hard time absorbing

Symptoms of iron deficiency: anemia: fatigue, headache.
Iron Deficiency

- **Good sources of Iron**
  - Meat: heme
  - Spinach, vegetables: poorly absorbed
  - Iron supplements: 300mg to 1gm/daily

Vitamin C helps iron absorption.
Many patients may need intravenous iron
With or without injections of erythropoetin (EPO).
Other Vitamins You May Need

**B12**: absorbed in terminal ileum
- symptoms: anemia neurologic
- need 4mg/day, can be given as a short or intranasal gel

**Folic Acid**: absorbed throughout small intestines, many medications (methotrexate, sulfasalazine) reduce folate levels
- symptoms: anemia, birth defects
- need: 1mg day
Other Vitamins You May Need

**Zinc**: frequently lost in diarrhea
- leads to: poor wound healing, impaired growth,
- rash, visual problems
- Need 2-4 mg day

**Antioxidants**: Vitamins C, E, Selenium, beta carotene,

What is an antioxidant? Certain disease states are associated with chemicals known as reactive oxygen species (ROS) which may induce tissue damage. Antioxidants reduce (eliminate) ROS.

No study has been shown a benefit from taking high doses of antioxidants.
Inflammatory Bowel Disease
Nutrition as Therapy?

*Role of Enteral Nutrition: Crohn’s disease*

- Potential Mechanisms
  - Correct Deficiencies
  - “Bowel Rest” elemental diet less antigenic stimuli
  - Antinflammatory: altered fat ratio, improved antioxidant status
Inflammatory Bowel Disease
Nutrition as Therapy?
Role of Enteral Nutrition: Crohn’s Disease

Meta-analysis:
11 Trials of Elemental vs. Polymeric Diet
3 Trials comparing low vs. high fat

<table>
<thead>
<tr>
<th>Comparison</th>
<th># Patients</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental vs Standard Enteral</td>
<td>334</td>
<td>1.1</td>
</tr>
<tr>
<td>Low vs. High Fat</td>
<td>209</td>
<td>1.13</td>
</tr>
<tr>
<td>Elemental vs Steroid</td>
<td>391</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No difference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No difference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Favors steroids</td>
</tr>
</tbody>
</table>

Elemental diet vs. steroids: effect on growth

<table>
<thead>
<tr>
<th>Study</th>
<th># patients</th>
<th>Intervention</th>
<th>Height Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas et al</td>
<td>24</td>
<td>Prednisolone +ASA</td>
<td>-3.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elemental diet</td>
<td>+0.32</td>
</tr>
<tr>
<td>Sanderson</td>
<td>17</td>
<td>ACTH/steroid/ASA</td>
<td>-2.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elemental diet</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Therapeutic Nutrition: Ulcerative Colitis

Seidner et al:

**RCT:** Enteral supplement containing 1.5 gm Omega-3 plus oligosaccharide/soluble fiber vs. placebo x 6 months
121 patients with mild to moderately active UC

Significantly less steroid use in supplement group

Clinical Gastroenterology Hepatology 2005
What about the......diet?

- **Specific Carbohydrate Diet (Gottschall Diet)**
  - **Concept:** excess undigested sugars (complex carbohydrates) make excess acidic compounds in the gut, causing tissue damage
  - **Avoid:** grains, pasta, processed meats, canned fruits, sugary syrups
  - **Typical Diet:**
    - Breakfast: baked apple, nut flour muffin, dilute juice
    - Lunch: tuna Salad, cheese, fruit based dessert
    - Dinner: Lean meat, cooked squash, peas, carrots
What about the diet?

- **Macrobiotic Diet (Virginia Harper)**
  - **Concept:** 50-60% grains, legumes, soy products, low fat high fiber, fish, pickled vegetables
  - **Avoid:** excessive animal protein, sugars, processed foods
  - **Typical Diet:**
    - **Breakfast:** Millet porridge, vegetable soup, cooked vegetables or fruit
    - **Lunch:** Couscous with squash, mixture of cooked and raw vegetables
    - **Dinner:** cooked lentils, soba noodles, fish, vegetables, fruit for dessert.
That’s nice so doctor, what can I eat?

- Avoid overly processed foods, additives, chemicals, excessive fats.
- Get enough Fiber
- Get enough calcium
- Emphasize good versus bad fats
- Know when you need supplements
- Don’t forget that the key to a healthy nutritional status is controlling your disease.
  
  – Take your medicines!