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The Guts and Bolts of the Diet and a Look into the Microbiome

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THE INFLAMMATORY BOWEL DISEASE ANTI-INFLAMMATORY DIET: THE IBD-AID

The Guts and Bolts of the diet and a look into the Microbiome

Barbara Olendzki, RD MPH
Asst. Professor, UMass Medical School
The Current Guidelines for IBD:

- “There is no need to avoid foods unless they worsen your symptoms. It is best to restrict as few foods as possible to increase the chances that you are getting a balanced, nutritious diet. This is important for maintaining the function of your digestive tract and your overall health.”

- If you do have a flare, follow a low-residue diet. Enteral nutrition may be helpful.

Crohn’s and Colitis Foundation of America (CCFA)
### A Brief History of IBD and Treatments

<table>
<thead>
<tr>
<th>United States</th>
<th>Asian countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>• First line treatment in Adults is medication:</td>
<td>• First line treatment in Adults is Enteral/Parenteral Nutrition^8</td>
</tr>
<tr>
<td>▪ Steroids</td>
<td>▪ Followed by Elimination diet</td>
</tr>
<tr>
<td>▪ 5-ASA</td>
<td>• Gradually re-introduce foods one at a time.</td>
</tr>
<tr>
<td>▪ Immune-modulating drugs</td>
<td>• If symptoms displayed, eliminate that food from diet.</td>
</tr>
<tr>
<td>• Low-residue diet (concern that fiber will irritate bowel)^11</td>
<td>▪ Low fat</td>
</tr>
</tbody>
</table>
An anti-inflammatory diet as treatment for inflammatory bowel disease: a case series report

Barbara C Olendzki¹, Taryn D Silverstein², Gioia M Persuitte¹, Yunsheng Ma¹, Katherine R Baldwin³ and David Cave²

Abstract

Background: The Anti-Inflammatory Diet (IBD-AID) is a nutritional regimen for inflammatory bowel disease (IBD) that restricts the intake of certain carbohydrates, includes the ingestion of pre- and probiotic foods, and modifies dietary fatty acids to demonstrate the potential of an adjunct dietary therapy for the treatment of IBD.

Methods: Forty patients with IBD were consecutively offered the IBD-AID to help treat their disease, and were retrospectively reviewed. Medical records of 11 of those patients underwent further review to determine changes in the Harvey Bradshaw Index (HBI) or Modified Truelove and Witts Severity Index (MTLWSI), before and after the diet.

Results: Of the 40 patients with IBD, 13 patients chose not to attempt the diet (33%). Twenty-four patients had either a good or very good response after reaching compliance (60%), and 3 patients’ results were mixed (7%). Of those 11 adult patients who underwent further medical record review, 8 with CD, and 3 with UC, the age range was 19–70 years, and they followed the diet for 4 or more weeks. After following the IBD-AID, all (100%) patients were able to discontinue at least one of their prior IBD medications, and all patients had symptom reduction including bowel frequency. The mean baseline HBI was 11 (range 1–20), and the mean follow-up score was 1.5 (range 0–3). The mean baseline MTLWSI was 7 (range 6–8), and the mean follow-up score was 0. The average decrease in the HBI was 9.5 and the average decrease in the MTLWSI was 7.

Conclusion: This case series indicates potential for the IBD-AID as an adjunct dietary therapy for the treatment of IBD. A randomized clinical trial is warranted.

Keywords: Diet, Inflammatory bowel disease, Nutrition
IBD-AID Pilot Study

- 40 pts from UMMHC gastroenterology clinics.
- 13 choose not to follow the prescription.
- 24 pts had a good or very good (remission) response to diet.
- 3 pts did not respond well (who complied), 2 were dx with C. diff, 1 unknown reasons.
- Subjects received nutrition instruction and counseling on the diet, with cooking classes available.
- Symptoms at baseline and at follow-up assessed.
  - Harvey Bradshaw Index for CD patients
  - Modified Truelove and Witts Severity Index for UC patients.
- Regular medical management by GI physicians continued.
## Targets of dietary components and IBD-AID

<table>
<thead>
<tr>
<th></th>
<th>Fatty Acids</th>
<th>Pre-Pro</th>
<th>Nutrient Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beneficial bacteria growth</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Short chain Fatty Acids production</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Mucin repletion</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Junction protein restoration</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Suppression of inflammatory eicosanoids</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Blockade of inflammation</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Suppression of immune response</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Reduction in oxidative stress</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Summary of Components for IBD-AID

1) Prebiotics
2) Probiotics
3) Beneficial nutrients, delivered in a way accepted by pt’s current digestive abilities
4) Avoidance of adverse foods (why?)
   1) Starve out the bad guys
   2) Simplify
   3) ↓ GMOs that may affect the balance of the microbiome
How IBD-AID fits in

- **Bacteria (restoring the balance)**
  - Probiotics
  - Prebiotics
  - Take away the food source of pathogenic bacteria (no grains except for oats, no refined sugars)

- **Barrier (repair intestinal epithelial structure)**
  - Dietary fiber (prebiotics) + probiotics → SCFA cause epithelial cell proliferation.
  - Some good bacteria induce expression of tight-junction proteins.

- **Target the Immune system and Inflammatory signals.**
  - Phytochemicals and antioxidants (variety of veggies + fruits)
  - Prebiotics + probiotics → SCFA (inhibits NF-κB)
  - Anti-inflammatory PUFAs
The Good Guys: Anti-IBD Factors

Dietary Fiber

Passes through the Small Intestine undigested

Fermentation by probiotic bacteria in the Colon

Short Chain Fatty Acids (SCFA)

Butyrate
Acetate
Propionate
Dietary Fiber helps restore Good Bacteria

- Prebiotics = type of fiber that specifically encourages beneficial bacterial growth. ¹
  - Examples: inulin and oligofructose, steel cut oats
  - Good sources of **inulin** include: artichokes, leeks, bananas, chicory root

- Stimulate growth of the “good guys” (Lactobacilli and Bifidobacteria) ¹
- Decrease colonic pH inhibiting growth of some pathogenic bacteria. ¹
Prebiotics

Imbalance between pathogens and commensals

Junction protein

Mucin layer

Probiotics

ω-6/ω-3

Obesity

Inflammation

IECs

M cell

Antioxidants

TNF-α, IL-6, IL-17, IL-1β, IL-13

NFκB activation

ROS/RNS formation

Antioxidants

6 (Adapted)
The Nefarious, Ne’er-do-well
NF-κB

NF-κB

This Story’s BAD GUY
How can we stop NF-κB activation?

**Dietary Inhibitors: focus on SCFA**

- Soluble fiber → fermentation by bacteria → SCFA (ex. Butyrate)
- Berries and oats are a great examples of fibrous foods that can be turned into butyrate.
- Butyrate inhibits the enzyme’s (IKK) phosphorylation of IκB

  - Result: NF-κB stays bound and inactive in the cytoplasm.
  - Stops the inflammatory cascade
  - Note: Exact mechanism of inhibition still to be determined.
  - It doesn’t work to just take butyrate supplements, the microorganisms are needed
- Low levels of luminal butyrate linked to chronic bowel inflammation. ²²
SCFAs help Repair Colonic Epithelium

- Butyrate has been shown to ↑ epithelial cell proliferation at the base of the colonic crypts.\textsuperscript{18}

- Better cellular electrolyte absorption \textsuperscript{18}

- Decreases TNF$\alpha$, thereby preventing cellular apoptosis
  - TNF$\alpha$ normally works to: \textsuperscript{12}
    - disrupt the epithelial barrier
    - induce apoptosis in epithelial cells
    - induce chemokine secretion in intestinal epithelial cells
E-nose Technology: IBD-AID

- Prospective study of dietary change with Enose measurements
  - Fermentome = the complex interplay between diet, symbiotic bacteria and volatile gases.
- Application of this technology:
  - The VOC chemical fingerprint and changes to it can help scientists investigate GI disorders.
- Prior research shows that the E-nose is able to distinguish between patients and controls as well as among patients with different diseases (Crohn’s, Ulcerative Colitis, Diabetes)
  - 97% separation rate.
Figure 3. Principal component analysis plot showing the distinct spatial characteristics between healthy volunteers and disease groups for the Cyrano A320 e-nose.
Case Study: UC

- June ‘12. 50yo, 5’8”, 168 lb. Has been following the SCD for 1 year. Currently bleeding, frequent stools. Introduced type of soluble fiber (ground flax), modified fatty acids.

- June ‘13. 175 lb. Still not well (energy, bleeding). Ready to transition to complete IBD-AID. Added oats, miso, other foods.

- March ‘14. 180 lb. Minimal bleeding, well-being significantly increased, exercising hard, looks great!
<table>
<thead>
<tr>
<th></th>
<th>SCD</th>
<th>SCD-IBD-AID</th>
<th>IBD-AID</th>
<th>Nominals</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>6/18/12</td>
<td>6/20/13</td>
<td>12/12/13</td>
<td></td>
</tr>
<tr>
<td>Pancreatic Elastase 1</td>
<td>110</td>
<td>198</td>
<td>269</td>
<td>&gt;=201 mcg/g</td>
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<tr>
<td>Putrefactive SCFAs</td>
<td>1.3</td>
<td>0.8</td>
<td>0.7</td>
<td>1.3-8.6 micromol/g</td>
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<tr>
<td>Eosinophil Protein X</td>
<td>3.1</td>
<td>0.3</td>
<td>3.3</td>
<td>&lt;=7.0 mcg/g</td>
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<tr>
<td>Calprotectin</td>
<td>65</td>
<td>37</td>
<td>49</td>
<td>&lt;=50 mcg/g</td>
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<tr>
<td>Beneficial SCFAs</td>
<td>7.2</td>
<td>37.7</td>
<td>71.7</td>
<td>&gt;=13.6 micromol/g</td>
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<tr>
<td>n-Butyrate</td>
<td>0</td>
<td>4</td>
<td>12.8</td>
<td>&gt;=2.5 micromol/g</td>
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### Beneficial Bacteria

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Lactobacillus</td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
</tr>
<tr>
<td>E coli</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
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<td>Bifido</td>
<td>3</td>
<td>1</td>
<td>3</td>
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### Additional Bacteria

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<tr>
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<tbody>
<tr>
<td>alpha haemolytic Streptococcus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
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<tr>
<td>gamma haemolytic</td>
<td></td>
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<td>4</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Streptococcus agalactiae gp B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Citrobacter freundi</td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
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<tr>
<td>Klebsiella oxytoca</td>
<td></td>
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<td></td>
<td>4</td>
</tr>
<tr>
<td>Bacillus species</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td></td>
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<td></td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Proteus mirabillis</td>
<td></td>
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</tbody>
</table>

Highlighted represents potentially pathogenetic bacteria.
<table>
<thead>
<tr>
<th>Lab</th>
<th>Date</th>
<th>Umass</th>
<th>Bordiuk</th>
<th>Quest</th>
<th>Umass</th>
<th>Nominal Values</th>
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<tbody>
<tr>
<td>Iron (mcg/dl)</td>
<td>7/30/13</td>
<td>94</td>
<td></td>
<td>86</td>
<td>116</td>
<td>45-182</td>
</tr>
<tr>
<td>Ferritin (ng/ml)</td>
<td>7/30/13</td>
<td>35</td>
<td></td>
<td>34</td>
<td>46</td>
<td>23-336</td>
</tr>
<tr>
<td>RBC (mil/mm³)</td>
<td>7/30/13</td>
<td></td>
<td>4.76</td>
<td>4.63</td>
<td>4.92</td>
<td>4.4-6</td>
</tr>
<tr>
<td>HGB (g/dl)</td>
<td>7/30/13</td>
<td>14</td>
<td>14.4</td>
<td>14.2</td>
<td>15.1</td>
<td>14-18</td>
</tr>
<tr>
<td>HCT (%)</td>
<td>7/30/13</td>
<td>42</td>
<td>43.6</td>
<td>42.8</td>
<td>44</td>
<td>42-52</td>
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<tr>
<td>D</td>
<td>7/30/13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30-100</td>
</tr>
<tr>
<td>ESR</td>
<td>7/13</td>
<td>7</td>
<td></td>
<td></td>
<td>10</td>
<td>0-20</td>
</tr>
<tr>
<td>Testosterone</td>
<td>7/13</td>
<td>320</td>
<td></td>
<td></td>
<td></td>
<td>175-781</td>
</tr>
<tr>
<td>CRP</td>
<td>7/13</td>
<td>0.3</td>
<td></td>
<td></td>
<td>1.1</td>
<td>&lt;10</td>
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<tr>
<td>WBC</td>
<td>7/13</td>
<td>7.6</td>
<td>6.2</td>
<td></td>
<td>6</td>
<td>4.3-10.3</td>
</tr>
</tbody>
</table>

Notes: 7/13: just after transfusion.
<table>
<thead>
<tr>
<th>Food, Pt</th>
<th>Phase 4 Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats, steel cut</td>
<td>Kale &amp; Fruit Smoothie</td>
</tr>
<tr>
<td>Nut Butter Bread</td>
<td>Frittata with Squash and Celeriac</td>
</tr>
<tr>
<td>Yogurt(SCDoph)/Banana</td>
<td>Home Fries</td>
</tr>
<tr>
<td>Nut Butter Bread</td>
<td>Gluten-Free Granola and Yogurt</td>
</tr>
<tr>
<td>Chicken Soup/Carrots/Broccoli</td>
<td>Red Pepper and Tomato Soup</td>
</tr>
<tr>
<td>Apple Sauce</td>
<td>Mediterranean Chickpeas and Vegetables</td>
</tr>
<tr>
<td>Yogurt(GIPro)</td>
<td>Coconut Curry Red Lentil Soup</td>
</tr>
<tr>
<td>Sauerkraut/Navy Beans</td>
<td>Cannellini Beans with Kale and Walnuts</td>
</tr>
<tr>
<td>Fish/Squash/Asparagus/Wakame/Flax</td>
<td>Chickpeas With Sole And Spinach</td>
</tr>
<tr>
<td>Yogurt(GIPro)/Banana</td>
<td>Tofu Stir Fry with Miso Sauce</td>
</tr>
<tr>
<td>Nut Butters</td>
<td>Cinnamon Apple Muffins</td>
</tr>
<tr>
<td></td>
<td>Guacamole and Cheddar Cheese Crackers</td>
</tr>
<tr>
<td></td>
<td>Crunchy Chickpeas</td>
</tr>
</tbody>
</table>
www.umassmed.edu/nutrition
References

References


Picture References

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