Effect of FODMAP (Fermentable Oligo-, Di-, Monosaccharides and Polyols) Restricted Diet on Symptoms of Gastroesophageal Reflux Disease

Primary Investigator: Sameer Waheed, M.B.B.S
Mentor: Dr. Henri Woodman, M.D
Introduction
What is Reflux Disease?

• Gastroesophageal Reflux Disease: A SYMPTOM based diagnosis:

• “symptoms or complications resulting from the reflux of gastric contents into the esophagus or beyond, into the oral cavity (including larynx) or lung”.

• The 2006 consensus meeting held at Montreal defined GERD as “a condition that develops when the reflux of stomach contents causes troublesome symptoms and/or complications”

• NERD and ERD

WHY STUDY GERD?

• 5 - 20% of individuals in US have GERD

• Annual Cost of 9 Billion Dollars
Dietary Intervention and GERD
Most studies have focused on the role of energy and lipids, but the data about their role is inconsistent[5-9].

2001 Case reports by William Yancy and Dawn Provenzale - The Concept of Ketogenic diet*

2006- Work by Gregory Austin et al.
So What Are FODMAPs?
FODMAPs

- Fermentable Oligo-, Di-, Monosaccharides and Polyols

- FODMAPs are short chain carbohydrates that are small molecules which are osmotically active and readily fermentable by bacteria

- Poorly and slowly absorbed in the small intestine

- FODMAPs have been shown to be fermented in the human colon and do not modify plasma glucose levels*

FODMAPs

• Over the past several years, studies have proven the benefit of FODMAPs restricted diet on symptoms of Irritable Bowel Syndrome (IBS)*.

• There is not sufficient evidence to prove the benefit of a FODMAPs restricted diet on symptoms of GERD.

FODMAPs

• Adherence to the FODMAP reduced diet has been assessed in two studies and these indicate durable adherence in up to 75% of patients*.

Objectives

• Primary:
  ▪ To demonstrate the effect of a low FODMAPs diet upon symptoms of GERD

• Secondary:
  ▪ To demonstrate the effect of a diet low FODMAPs upon Symptoms of Irritable Bowel Syndrome
Study Design and Methods
Study Design

- Prospective Cohort Study

- Inclusion Criteria:
  - Age between 20 and 70 years
  - Willingness to use FODMAP diet
  - Active Symptoms of GERD

- Exclusion Criteria
  - Previous antireflux surgeries
  - Unwillingness to consider FODMAP diet
  - Specific food allergies limiting use of FODMAP Choices
  - Symptoms of GERD quantified through validated symptoms score
Symptoms Scores for GERD

A good symptoms score should have the following qualities:

1. Sensitive enough to diagnose the disease
2. Easily scored
3. Easily understandable
4. Easily translatable into local languages
5. Able to evaluate the disease as completely as possible, covering all types of typical and atypical symptoms
6. Able to assess changes with therapy over shorter as well as longer duration
7. Self reported/ self administered
8. Economical
9. Psychometrically validated in clinical trial
GERD Symptoms Assessment Score (GSAS-ds)

- Score developed to be administered before and after intervention.

- Set of 15 questions subdivided into 4 (0-3) intensities each.

- Validated and shown to have acceptable reliability, content validity and construct validity and sensitive to changes in severity of symptoms and to changes over time.*

Patients at Gi lab of SBMH/ GERD

Patients at MCCC* (n= 30)

Investigators Meet the Patients and Evaluate Eligibility for Participation in the Study; consent filled

Education about FODMAPs Diet Provided

First Symptoms Score Filled out and Net Score Calculated; Diet Trial for One Week Begins

Second Score Filled Out at End of The Week

Food Diary Maintained

Written informed consent obtained; Ph studies obtained if available

One Week Recipes of FODMAP diet provided

Investigator Contacts Patients to assure compliance and answers questions

De-Meester Score for Ph monitoring calculated.

Data analyzed via Microsoft Excel 2013

*South Buffalo Mercy Hospital Mercy Comprehensive Care Center
# Demographic Distribution of Study Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number (n)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>173 lbs</td>
<td>22</td>
</tr>
<tr>
<td>BMI</td>
<td>29.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Age</td>
<td>42</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender %</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>
LOW FODMAPS GROCERY LIST

PRODUCE

VEGETABLES
- Baked beans
- Chickpeas, lentils
- Kidney beans, soy beans

FRUIT
- Banana, blueberry
- Grapefruit, grapes
- Honeydew melon
- Kiwi, lemon, lime
- Mandarin oranges
- Orange, raspberry
- Strawberry

LEGUMES
- Custard, ice cream
- Marjarine, milk (cow, goat, sheep)
- Soft cheese (including cottage cheese and ricotta)
- Yogurt

SUITABLE FOODS FOR A LOW-FODMAP DIET

FRUIT
- Bell peppers, bok choy, carrots
- Celery, corn
- Eggplant, green beans, lettuce
- Parsnips, scallions
- Spinach, sweet potato, white potato, tomato

SWEETENERS
- Artificial sweeteners that do not end in “ol”, glucose, maple syrup, sugar

STAPLES
- Meats, fats, eggs

LACTOSE ALTERNATIVES
- Butter, hard cheese, brioe, and camembert
- Lactose-free products, such as lactose-free ice cream and yogourt, galato, rice milk & sorbet

GRAINS
- Oats, gluten-free products & spelt products
RESULTS
Figure 1: Change in Symptoms Score Pre and Post FODMAP Trial

Change in Mean Symptom Score

<table>
<thead>
<tr>
<th>Mean Pre Diet Score</th>
<th>Mean Post Diet Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5</td>
<td>18.96666667</td>
</tr>
</tbody>
</table>

ST Error 0.41

p < 0.001

ST Error 0.44
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Mean Pre Diet Score</th>
<th>Mean Post Diet Score</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Burn or Burning Sensation</td>
<td>1.7</td>
<td>1.133</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Feeling Pressure/discomfort Chest</td>
<td>1.533</td>
<td>1.2</td>
<td>0.0023</td>
</tr>
<tr>
<td>Food coming back to mouth</td>
<td>1.566</td>
<td>1.233</td>
<td>0.0023</td>
</tr>
<tr>
<td>Acid or Sour Taste in Mouth</td>
<td>1.66</td>
<td>1.333</td>
<td>0.0023</td>
</tr>
<tr>
<td>Frequent gurgling in stomach</td>
<td>1.633</td>
<td>1.233</td>
<td>0.0014</td>
</tr>
<tr>
<td>Feeling of Pressure or Lump in Throat</td>
<td>1.6</td>
<td>1.166</td>
<td>0.0015</td>
</tr>
<tr>
<td>Nausea</td>
<td>1.1</td>
<td>0.9</td>
<td>0.0117</td>
</tr>
<tr>
<td>Burning Pain in Throat</td>
<td>1.166</td>
<td>1.033</td>
<td>0.1033</td>
</tr>
<tr>
<td>Bloating or Feeling Need to Loosen Belt</td>
<td>1.366</td>
<td>1.23</td>
<td>0.0434</td>
</tr>
<tr>
<td>Belching</td>
<td>1.466</td>
<td>1.33</td>
<td>0.2113</td>
</tr>
<tr>
<td>Flatulence or Passing Gas</td>
<td>1.466</td>
<td>1.2</td>
<td>0.0299</td>
</tr>
<tr>
<td>Feeling Full After Eating Little</td>
<td>1.333</td>
<td>1.166</td>
<td>0.0573</td>
</tr>
<tr>
<td>Bad Breath</td>
<td>1.166</td>
<td>1.133</td>
<td>0.7122</td>
</tr>
<tr>
<td>Coughing</td>
<td>1.1</td>
<td>1.166</td>
<td>0.4235</td>
</tr>
<tr>
<td>Hoarseness of Voice</td>
<td>1.033</td>
<td>1.033</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 3: Percentage of Patients with Symptomatic Improvement

- 73% Statistically significant symptomatic improvement
- 27% Patients with no statistical improvement
Figure 4:

**Changes in Symptoms Pre and Post Diet**

- Heart Burn or Burning Sensation: Pre Diet, $p = 7 \times 10^{-6}$; Post Diet
- Feeling Pressure/discomfort Chest: Pre Diet, Post Diet, $p = 0.0023$
- Food coming back to mouth: Pre Diet, $p = 0.0023$
Figure 5:

Changes in Symptoms Pre and Post Diet

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Pre Diet</th>
<th>Post Diet</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid or Sour Taste in Mouth</td>
<td></td>
<td></td>
<td>0.0023</td>
</tr>
<tr>
<td>Frequent gurgling in stomach</td>
<td></td>
<td></td>
<td>0.0014</td>
</tr>
<tr>
<td>Feeling of Pressure or Lump in Throat</td>
<td></td>
<td></td>
<td>0.0015</td>
</tr>
</tbody>
</table>
Figure 6:

Change in Nausea Pre and Post Diet

![Bar chart showing the change in nausea score before and after diet]

\[ \rho = 0.011 \]

Change in Symptoms Pre and Post Diet

![Bar chart showing the change in symptoms score before and after diet]

\[ \rho = 0.04 \]
Figure 7:

**Change in Symptoms Score Pre and Post Diet**

- *Flatulence or Passing Gas*
  - Pre Diet: 1.4
  - Post Diet: 1.2
  - $p = 0.04$

- *Feeling Full After Eating Little*
  - Pre Diet: 1.35
  - Post Diet: 1.15
  - $p = 0.05$
Patients with GERD and Irritable Bowel Syndrome experiencing improved IBS Symptoms with low FODMAP Diet ($P = 0.0351$) vs Patients with IBS and GERD experiencing improved GERD ($P = 0.084$):

<table>
<thead>
<tr>
<th>Patients with GERD and Irritable Bowel Syndrome</th>
<th>Patients Experiencing Improved IBS Symptoms with low FODMAP Diet ($P = 0.0351$)</th>
<th>Patients with IBS and GERD experiencing improved GERD ($P = 0.084$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>
Figure 9: Correlation Between GSAS Score and DE-Meester Score

\[ R = 0.302 \]
\[ R^2 = 0.091 \]
Figure 10: Correlation Between De Meester Score and Composite Symptoms Score

R = 0.32
R^2 = 0.10
Conclusions/Discussion
A low FODMAP diet relieved the cardinal symptoms of GERD.

The exact mechanism underlying the effect of FODMAP diet is not understood. Some physiological effects of low FODMAP diet are:

<table>
<thead>
<tr>
<th>Osmotic Effects</th>
<th>Ileostomy output increases in proportion to recovered FODMAPs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased liquid content of small intestine after mannitol by magnetic resonance imaging</td>
</tr>
<tr>
<td></td>
<td>Severity of diarrhea directly proportional to chain length of FODMAP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bacterial Fermentation</th>
<th>Marked increase in breath hydrogen over entire day and reduced methane production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rapidity of Hydrogen production inversely proportional to change length of FODMAPs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motility Effects</th>
<th>Osmotic effects of FODMAPs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neural feedback pathway and/or hormonal changes from short chain fatty acid production secondary to bacterial fermentation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probiotic effects</th>
<th>Oligosaccharides in small doses preferentially metabolized by bifidobacteria and lactobacilli</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Systemic Effects</th>
<th>Tiredness in women with IBS related to high FODMAP diet. Toxic metabolites of malabsorption of FODMAPs postulated</th>
</tr>
</thead>
</table>

**FODMAPs:** Fermentable Oligo-, Di-, Monosaccharides and Polyols

Other Possible Mechanisms

1. Possible elimination of lactose from diet which has been shown to aggravate reflux symptoms and increase Transient Lower Esophageal Sphincter Relaxations (TLESRs)*

2. Authors have focused on the role of hormones like Cholecystokinin, Peptide Y, Somatostatins and Gamma Amino butyric Acid. However, there are no studies evaluating the effect of low carbohydrates on these neurohormones.

3. The Ileal brake phenomenon - Negative feedback from proximal gut to the stomach affecting its motility and secretory functions.

4. Placebo effect?

• De-Meester score of esophageal pH monitoring was not correlated with the severity of symptoms of GERD and neither with response to the low FODMAP diet

• Previous studies by Wiener Gj et al. and Vaezi MF, Schroeder PL et al. have shown that 24 hour PH monitoring does not identify significant portion of patients with clinical reflux*

• Concept of Alkaline reflux has to be taken into account

• On PPI therapy Ph monitoring.

Conclusions Continued

- Symptoms of IBS improved with low FODMAPs diet which is in line of multitude of other studies*

- Symptomatic GERD improvement in IBS patients did not achieve statistical significance which could be related to small sample and or inadequate follow up period for IBS


Limitations of the Study
- Small Sample Size
- Absence of Control group
- Inherent limitations of a diet based study
  - Recall bias
  - Compliance issue
  - Difficulty designing placebo group
- On therapy esophageal PH monitoring
Acknowledgements

- Dr. Henri Woodman
- Catholic Health Institutional Review Board
- My Wife
Thank You