Embracing Metabolic Surgery as a Treatment for Type 2 Diabetes
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Objectives
• Describe the mechanisms of diabetes improvement from metabolic surgery
• State one nutrition protocol for preoperative and postoperative metabolic surgery patients
• Identify an appropriate candidate for metabolic surgery

Agenda
• Metabolic Surgery
  – What is it?
  – How does it work?
• Nutrition Protocols
  – Pre-, peri-, & postoperative management
• Appropriate Candidates
  – Who and how to refer
  – Communicating about surgery
Did you know...?

Efficacy of Bariatric Surgery

Did you also know...?

Sjostrom et al. 2007
Diabetes & Obesity

Almost 90% of people with type 2 diabetes have obesity

6-fold increase in diabetes development for people with BMI > 40 compared to normal BMI

People with diabetes have annual health care expenditures of $13,581 compared to $3,954 for those without diabetes

Yee et al. 2017

Efficacy of Metabolic Surgery

What’s in a Name?

• Proposed definition for Metabolic Surgery
  – A set of gastrointestinal operations used with the intent to treat diabetes and metabolic dysfunctions (which include obesity)

Rubino et al. 2014

Schauer et al. 2016
Professional Consensus

1st Diabetes Surgery Summit (Rome)
- Metabolic surgery seems legitimate but RCTs needed

2nd Diabetes Surgery Summit (London)
- Sufficient evidence to support metabolic surgery as antidiabetes treatment

Common Metabolic Surgeries

<table>
<thead>
<tr>
<th>AGB</th>
<th>RYGB</th>
<th>GS</th>
<th>BPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable Gastric Banding</td>
<td>Roux-en-Y Gastric Bypass</td>
<td>Sleeve Gastrectomy</td>
<td>Biliopancreatic Diversion with Duodenal Switch</td>
</tr>
</tbody>
</table>

BPD with Duodenal Switch
- Developed in 1988 in Ohio
  - Create sleeve and keep 2-4 cm duodenum
  - Dissect duodenum and ileum
  - Common channel is 80-150 cm
- 70-75% EWL
- Micronutrient & macronutrient malabsorption

Sources:
- Elder & Wolfe 2007; ASMBS 2004
Gastric Bypass

• Developed in 1970s
  – Upper part of stomach dissected to create pouch
  – Jejunum dissected and connected to pouch
• 60-70% EWL
• Micronutrient malabsorption
• Dumping syndrome
• GJ ulcer

Sleeve Gastrectomy

• Used as first step to BPD in 2000
  – Stomach is vertically dissected; about 80% is removed
• 50-60% EWL
• Strictures
• Leaks
• Micronutrient malabsorption
• Complicated relationship with heartburn

The Main Metabolic Players

<table>
<thead>
<tr>
<th>Incretins</th>
<th>Ghrelin</th>
<th>Leptin</th>
<th>PYY &amp; CCK</th>
<th>Bile Acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Induce insulin secretion in response to food</td>
<td>• Signals hunger in response to empty stomach</td>
<td>• Signals need for increase energy consumption</td>
<td>• Inhibit gastric emptying; reduce appetite</td>
<td>• Improve glucose tolerance through FXR activation</td>
</tr>
</tbody>
</table>

Elder & Wolfe 2007; ASMBS 2004

ASMB 2004
The Main Metabolic Players

- Bile acids
- Ghrelin
- CCK
- GLP-1
- PYY
- Leptin

Albaugh et al. 2017; Meek et al. 2016

Potential Mechanisms

A. Immediate Impact of Surgery
- Increase in insulin sensitivity
- Increase in B-cell function
- Reduction in hepatic fat

B. Potential mediators/mechanisms
- Reduced ghrelin production
- Reduced glucagon production
- Reduced glucose production
- Reduced glucose utilization
- Reduced glycemic control

C. Effect on glucose homeostasis
- Improved insulin sensitivity
- Improved insulin secretion
- Reduced hepatic glucose production
- Reduced glucose utilization
- Increased glucose effectiveness

Batterham & Cummings 2016

Immediate Impacts

- Increase in insulin sensitivity
- Calorie Restriction
- Reduction in hepatic fat
- Increase in B-cell function

Batterham & Cummings 2016
Immediate Impacts

- Delays mixing of bile acids & ingested food
- Bypassing upper intestine
- Gut microbiome changes
- Diminishes anti-incretin signal

Batterham & Cummings 2016

Immediate Impacts

- Increased GLP-1 secretion
- Increased expression glucose transporters
- Expedites lower intestine access
- Increased PYY secretion

Batterham & Cummings 2016

Metabolic Surgery Outcomes

Schauer et al. 2016
Outcome Definitions

Complete Remission
• FBG < 100 mg/dl
• A1C < 6%
• For at least 1 year without antidiabetic meds

Partial Remission
• FBG < 126 mg/dl
• A1C < 6.5%
• For at least 1 year without antidiabetic meds

Difference in Definitions

Fig 1 Remission of diabetes after gastric bypass, sleeve gastrectomy and gastric banding based on the new (2009 consensus statement) and the previous27 definitions. P < 0.001

NUTRITION MANAGEMENT
Preoperative Management

• Assess nutrition status
• Improve glycemic control
• Manage expectations
• Educate on lifestyle changes
• Prevent hypoglycemia during pre-op diet

Assess Nutrition Status

“All patients should undergo an appropriate nutritional evaluation, including micronutrient measurements, before any bariatric surgical procedure.”

- LFTs
- Lipids
- CBC with differential
- HbA1C
- Serum iron, ferritin, & TIBC
- Serum B1 & B12
- Serum folate or plasma homocysteine
- Serum Ca & alkaline phosphatase
- PTH & 25(OH)-D

Cummings & Isom 2014; Mechanick et al. 2013

Improve Glycemic Control

• Optimize preoperative glycemic control via medical nutrition therapy, physical activity, oral meds, and insulin
• HbA1C
  – Ideally ≤ 7.0%
  – 7.0-8.0% in case of extensive comorbidities
  – > 8.0% - use clinical judgment
• Blood glucose
  – Fasting ≤ 110 mg/dL
  – 2-hour postprandial ≤ 140 mg/dL

Cummings & Isom 2014; Mechanick et al. 2013
Preoperative Education

Effect of surgery on digestion and absorption
Eating behaviors to prevent GI distress
Preoperative diet protocol
Postoperative diet protocol
Micronutrient supplementation

Pre-op Diets

- Pre-op diets are low in carbohydrates to reduce liver glycogen stores
  - Evidence-based protocol: 1000 kcal, 50-60 g carbohydrate daily for 2 weeks

Preventing Hypoglycemia

- Highest risk meds
  - Insulin
  - Sulfonylureas
  - Thiazolidinediones
  - SGLT2 inhibitors
- Increase daily carbohydrate intake
- Treat lows with glucose tablets
- Collaborate with primary care provider or endocrinologist to adjust meds

Colles et al. 2006
Immediate Post-op Management

Inpatient Glycemic Protocol for Patients with Diabetes Undergoing Bariatric Surgery

• Interdisciplinary workgroup published a protocol in 2015

Glycemic Control Protocol

- Target for random BG: 120-180 mg/dl
- Test with finger sticks every 6 hours
- Initiate basal insulin (glargine) at 0.2 units/kg
  – Adjust up or down based on BG results and need for correctional insulin
- IV D50 or glucose tablets can be used to treat lows
Discharge Protocol Highlights

• Follow up with PCP or endocrinologist in 2-4 weeks
• Suggestion to hold metformin for 2-3 weeks due to risk of nausea
  – Extended release typically best tolerated
• Consider DPP-4 inhibitor
• Test with finger sticks 2x/day
• Treat lows with glucose tablets

<table>
<thead>
<tr>
<th>Diet Stage</th>
<th>Duration</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Liquids</td>
<td>4-24 hours</td>
<td>Sugar-free, low-calorie, noncarbonated beverages</td>
</tr>
<tr>
<td>Protein Supplements + Semi-Solid Foods</td>
<td>14-21 days (7 days band)</td>
<td>Protein supplements, yogurt, smooth soups, cottage cheese, ricotta cheese, pureed fruits and vegetables</td>
</tr>
<tr>
<td>Soft Textures</td>
<td>14-21 days (7 days band)</td>
<td>Tender poultry and fish, tofu, eggs, legumes, hot cereal (oatmeal, cream of wheat), soft fruits with no peels and seeds, well-cooked vegetables with no peels and seeds</td>
</tr>
<tr>
<td>Regular Textures</td>
<td>Lifelong</td>
<td>Guide patient toward balanced diet with lean protein, fruits, vegetables, whole grains, healthy fats, and low-fat dairy (if desired). Foods initially challenging to tolerate include red meat, raw vegetables, bread, rice, and pasta.</td>
</tr>
</tbody>
</table>

Micronutrient Needs

• Reduced intake of food after surgery
  – Potential aversions and food intolerances

• Changes to GI tract
  – Intrinsic Factor (IF) in fundus of stomach
  – Fewer parietal cells secreting hydorchloric acid (HCl)
    • Less acidic environment
  – Bypass of duodenum and jejunum
Micronutrient Needs

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Requirement</th>
</tr>
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<tbody>
<tr>
<td>Iron</td>
<td>18-60 mg</td>
</tr>
<tr>
<td>Folate</td>
<td>350-500 mcg</td>
</tr>
<tr>
<td>B12</td>
<td>350-500 mcg</td>
</tr>
<tr>
<td>Thiamin</td>
<td>12-50 mg</td>
</tr>
<tr>
<td>Calcium</td>
<td>1200-2400 mg</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>3000 IU</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>5000-10000 IU</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>15 mg</td>
</tr>
<tr>
<td>Folate</td>
<td>350-500 mcg</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>90-300 mcg</td>
</tr>
<tr>
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<td>90-300 mcg</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>15 mg</td>
</tr>
<tr>
<td>Zinc</td>
<td>8-22 mg</td>
</tr>
<tr>
<td>Copper</td>
<td>1-2 mg</td>
</tr>
<tr>
<td>Selenium &amp; Magnesium</td>
<td></td>
</tr>
</tbody>
</table>

Pathophysiology of Dumping Syndrome

- Rapid passage of nutrients to the small intestine which causes an osmotic fluid shift
- Triggered by simple carbohydrates
- Symptoms are gastrointestinal and vasomotor

Lack of pyloric sphincter → Fluid shift

Tack 2009
Pathophysiology of Dumping Syndrome

Kanth & Roy 2017

Nutrition Intervention

• Avoid added sugars in beverages and foods
  – Sometimes natural sugars (fructose, lactose) can be problematic

• Avoid eating and drinking at the same time
  – Drink 30 to 60 min after eating
  – Be mindful of watery foods like soups

• Pectin, guar gum, glucomannan?

Tack 2009

Pathophysiology of Reactive Hypoglycemia

• Rapid hypoglycemia from exaggerated insulin response (incretin effect)
• Food moves to small intestine more quickly; triggers hormone release (GLP-1 and GIP) which stimulates insulin response
• Symptoms of hypoglycemia occur 1-3 hours after a meal

Ukleja 2006
**Nutrition Intervention**

**Goal:** Delay transit of food through GI tract

- Small, frequent meals (5-6 times per day)
- Limit carbohydrate to 15-30 grams per meal
  - Choose complex carbohydrate foods
- Have source of protein and/or fat at each meal
- Avoid drinking during meal and 30 min after
- Pectin, guar gum, glucomannan?

Ukleja 2006; Botros et al. 2014; Ritz et al. 2012

**Beyond Nutrition Management**

- Acarbose (glucosidase inhibitor) may be used in addition to diet intervention
- Reversal of gastric bypass
- Partial pancreatectomy

Ukleja 2006

**CANDIDATES FOR SURGERY**
Candidates for Surgery

- BMI 40+
- BMI 30-39.9 when hyperglycemia is inadequately controlled by lifestyle and medical therapy
- Lower BMI thresholds by 2.5 for Asian patients

Schauer et al. 2016

Expanding the Candidate Pool

Predictors of Outcomes

Higher remission rates
- T2DM < 8 years
- Lower pre-op FG
- RNY or BPD-DS

T2DM > 8 years
- Pre-op need for insulin
- Poorer glycemic control
- Low C-peptide levels

Batterham & Cummings 2016; Schauer et al. 2016
Barriers to Surgery

- Lack of knowledge about surgery – patient and/or provider
- Weight bias
- Limited access to care
- Insurance coverage

Building Blocks of Policy Change

1. Communicate scale of diabetes challenge
2. Articulate role for bariatric/metabolic surgery
3. Identify cost-effectiveness / savings
4. Explore resources / processes to support surgery access
5. Reframing ‘diabetes surgery’

Referring a Candidate

- Find out how patients feel about surgery
- Find out how providers feel about surgery
- Advocate with data
- Look for MBSAQIP accredited centers
Summary

• Metabolic surgery is an effective but underused treatment for type 2 diabetes.
• Dietitians play a key role in optimizing pre- and post-op success.
• Early referral to surgery and management of expectations are important components of care.

References

• Albaugh VL, Flynn CR, Cai S, Xiao Y, Tamboli RA, Abumrad NN. Early Increases in Bile Acids Post Roux-en-Y Gastric Bypass Are Driven by Insulin-Sensitizing, Secondary Bile Acids. J Clin Endocrinol Metab. 2015 Sep;100(9):E1225-33

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• Cummings DE and Cohen RV. Bariatric/Metabolic Surgery to Treat Type 2 Diabetes in Patients With a BMI <35 kg/m2. Diabetes Care, 2016; 39(6): 924-933. https://doi.org/10.2337/dc16-0350
References


References


