What’s New In Bariatric Endoscopy?

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Acknowledgements

- No disclosures
- Thanks to Marvin Ryou for slides
- Marvin Ryou and Chris Thompson do all endoscopic bariatric procedures at BWH
Objectives

- Understand the impact of the current obesity epidemic
- Be familiar with the current surgical techniques
- Understand the emerging role for endoscopy as primary therapy for obesity
Classification of obesity

Qualify for surgery

BMI ≥ 35 with co-morbid illness
BMI ≥ 40
WHO estimated for 2015, 2.3 billion adults overweight, and > 700 million obese
Obesity in the United States 2015

Source: Behavioral Risk Factor Surveillance System
BMI and mortality

Exponential Increase in Risk

Relative Mortality Rate

High risk
Medium risk
Low risk
Types of bariatric surgery

- Adjustable laparoscopic band
- Vertical banded gastroplasty
- Sleeve gastrectomy
- Roux-en-Y gastrojejunostomy
- Biliopancreatic diversion/duodenal switch
Current surgical treatments

<table>
<thead>
<tr>
<th>Invasiveness</th>
<th>Adj. Gastric Band</th>
<th>Vertical Banded Gastro</th>
<th>Sleeve Gastrectomy</th>
<th>Roux-en-Y</th>
<th>BPD/DS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Restricted</td>
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<td>Malabsorbptive</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>WL @ 1 yr [kg]</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>44</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality [%]</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.5 (0.3 HVC)</td>
<td>1.1</td>
</tr>
<tr>
<td>SAEs* [%]</td>
<td>&lt;0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.8</td>
<td>1.8</td>
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<tr>
<td>GI Symptoms [%]</td>
<td>7.0</td>
<td>20-56%</td>
<td>10</td>
<td>16.9</td>
<td>37.7</td>
</tr>
</tbody>
</table>

BPD/DS: Biliopancreatic Diversion with Duodenal Switch
Number and types of bariatric surgeries in the United States

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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</thead>
<tbody>
<tr>
<td>TOTAL*</td>
<td>158,000</td>
<td>173,000</td>
<td>179,000</td>
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<tr>
<td>Roux-en-Y Gastric Bypass</td>
<td>36.7%</td>
<td>37.5%</td>
<td>34.2%</td>
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<tr>
<td>Gastric Band</td>
<td>35.4%</td>
<td>20.2%</td>
<td>14.0%</td>
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<tr>
<td>Sleeve Gastrectomy</td>
<td>17.8%</td>
<td>33.0%</td>
<td>42.1%</td>
</tr>
<tr>
<td>Biliopancreatic Diversion with Duodenal Switch (BPD-DS)</td>
<td>0.9%</td>
<td>1.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Revisions</td>
<td>6.0%</td>
<td>6.0%</td>
<td>6.0%</td>
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<tr>
<td>Other</td>
<td>3.2%</td>
<td>2.3%</td>
<td>2.7%</td>
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</table>

*ASMB/BSA Total bariatric procedures numbers from 2011, 2012 and 2013 based on the best estimation from available data (BOLD, ASB/ABSAQIP, National Inpatient Sample data and outpatient estimations).
Effectiveness of surgical treatments at 3 years

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Weight Loss (kg)</th>
<th>95% CI</th>
<th>No. of Studies</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open RYGB</td>
<td>41.6</td>
<td>37.4 - 45.8</td>
<td>20</td>
<td>1266</td>
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<tr>
<td>Laparoscopic RYGB</td>
<td>38.2</td>
<td>28.0 - 48.6</td>
<td>1</td>
<td>15</td>
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<tr>
<td>VBG</td>
<td>32.0</td>
<td>27.7 - 36.4</td>
<td>18</td>
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<td>LAGB</td>
<td>34.8</td>
<td>29.5 - 40.1</td>
<td>17</td>
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<tr>
<td>BPD</td>
<td>53.1</td>
<td>47.4 - 58.8</td>
<td>1</td>
<td>50</td>
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</table>

American Society for Metabolic and Bariatric Surgery 2014
Weight loss at 10 years

Figure 1. Weight Changes among Subjects in the SOS Study over a 10-Year Period.

All data are for subjects who completed 10 years of the study. The average weight change in the entire group of surgically treated subjects was almost identical to that in the subgroup of subjects who underwent vertical banded gastroplasty. The I bars represent the 95 percent confidence intervals.

Gastric bypass surgical revision

- **Open revision**
  - Early morbidity 15 to 50%
  - Emergent re-operation in 5%
  - Mortality 2%
  - Similar late complication rates

- **Laparoscopic revision**
  - Technically challenging
  - Conversion rates as high as 48% reported
  - More complications requiring early surgery vs. open revision

- Requires in-patient hospital stay

Parikh M. *Obes Surg* 2011;21:650-4
Roux-en-Y gastric bypass anatomy

- Small volume gastric pouch
- Small gastrojejunostomy
- Variable length Roux limb
- Transected gastric pouch
  - Reduces risk of staple line dehiscence and gastro-gastric fistula
RYGB – complications

- Perioperative complications
  - Bleeding
  - Anastomotic leaks
  - Marginal ulcer

- Late complications
  - GJ stenosis
  - Fistulas and leaks
  - GJ dilation
Endoscopic procedures after bariatric surgery

- Bleeding
- Fistula and leak repair
- Stenosis
- Weight regain due to GJ dilation
  - Injection sclerotherapy
  - Argon plasma coagulation (APC)
  - Suturing (transoral outlet reduction-TORE)
  - Restorative obesity surgery endoluminal-ROSE
- ERCP
Primary endoscopic bariatric therapies
Obesity treatment: risk vs. effectiveness

- Diet/Drugs: Low Risk - Low Effectiveness
- Endolumenal Bariatrics?: High Risk - High Effectiveness
- Lap Band
- VBG
- Sleeve Gastr.
- Gastric Bypass
- BPD/DS

Diet/Drugs and Endolumenal Bariatrics? are at the center with risk and effectiveness levels indicated by color and label.
New treatment categories

- Revision
- Bridge
- Early intervention
- Primary therapy
- Comorbidities
  - Diabetes
  - NAFLD
  - Metabolic syndrome
Current endoscopic bariatric therapy strategies

- Intragastric balloons (Orbera, ReShape)
- Aspiration therapy (Aspire)
- Duodenal sleeves (GI Dynamics)
- Endoscopic suturing (Apollo)
- Endoscopic plications, including POSE
- Duodenal resurfacing (Fractyl)
- Intestinal partial bypass (GI Windows)
Intragastric balloons

- Orbera
- Helioscopie
- Obalon
- PlenSat
- ReShape
- Tulip Medical
- Spatz adjustable FGIA
- Allurion
Orbera

- 6 Month implant
- For BMI’s 30-40
- FDA approved in 2015 and acquired by Apollo from Allergen
- 200,000 Orbera procedures performed worldwide

Schulte SOARD 2010
Orbera efficacy

- Meta-analysis of 17 studies and 1638 pts
- Weight loss at 12 months = **25.4% EWL**

Abu Dayyeh BK. *Gastrointest Endosc* 2015;82:425-438

<table>
<thead>
<tr>
<th>Study name</th>
<th>Subgroup within study</th>
<th>Mean</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Total</th>
<th>% EWL</th>
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<tr>
<td>Sallet 2004</td>
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<td>Al Kahtan 2009</td>
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<td>0.667</td>
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<td>Orbera</td>
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<td>31.495</td>
<td>38.305</td>
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<td>Dogan 2013</td>
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<td>9.743</td>
<td>23.657</td>
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<td>Orbera</td>
<td>32.700</td>
<td>23.900</td>
<td>41.500</td>
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<td>Random</td>
<td></td>
<td>25.441</td>
<td>21.457</td>
<td>29.426</td>
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</tbody>
</table>
Orbera adverse events

- Abdominal pain in 33.7%
- Nausea in 29%
- Early removal in 7.5%
- Migration in 1.4%
- Gastric perforation 0.1%

Abu Dayyeh BK. *Gastrointest Endosc* 2015;82:425-438
Obalon

- Swallow-able balloon attached to thin tube for inflation
- After x-ray confirming placement, nitrogen fills balloon; tube detached
- Performed without sedation
- Up to 3 balloons possible
- Endoscopically removed after 6 months
- FDA approved 2016
ReShape

- Dual balloon
- Theoretically addresses migration and safety issues associated with single balloon devices
- Fill with 900 cc saline
- FDA approved in 2015
Intragastric balloons and NAFLD

- Meta-analysis of 9 observational studies and one RCT
- ALT decreased by 10.01 U/L
- GGT decreased by 9.82 U/L
- BMI decreased by 4.98 kg/m²
- Decreased hepatic steatosis by US/MRI
- Histological NAFLD score lower (2 vs 4)

Popov VM. *Dig Dis Sci* 2016;61:2477-87
Gelesis Attiva

- Pill made from indigestible edible fiber
- Fiber swells in contact with water
  - Food more viscous
  - Stays in stomach longer
  - Increases satiety
- Pill gradually biodegradable
- Study of 95 patients: Well tolerated but 16% with side effects (nausea and constipation)
- Not FDA approved
Aspire Assist

- Modified PEG
- Hand held device attached to port after meal
- Empty 1/3 of contents
- Patient cannot exceed a certain number of aspirations per month
- Conditional FDA approval
Aspire RCT (US Pivotal)

- 171 patients
- Mean BMI = 42
- 2:1 Randomization to Aspire + lifestyle counseling versus lifestyle counseling alone
- 1 year study
- 31.5% EWL vs 9.8% EWL (mITT)
- 37.2% EWL vs 13.0% EWL (PP)
- 58.6% of patients achieved at least 25%EWL at 1 year (mITT)

Thompson CC. Presented at Digestive Disease Week, May 2016
USGI

- Delivers novel tissue anchors to create plications
- Primary weight loss procedure = POSE
- ROSE is for revision of gastric bypass anatomy
- 62% EWL for POSE at 12 mo
- Not FDA approved
USGI POSE ESSENTIAL trial

- Randomized, blinded, sham-controlled
- Class I/II Obesity
- 332 patients enrolled, 2:1 randomization
- Mean 13.5 suture anchors placed;
- Mean procedure time 39.7 min
- Weight loss 4.9% in treatment arm and 1.4% in controls (3.6 X higher with treatment)
- Response rate 41.6% treatment vs 22% control
- Trial did not meet primary endpoints

Sullivan S. Abstract #100. Presented at: Digestive Disease Week; 2016
Apollo OverStitch

- Mounts on double channel endoscope
- Version for single channel endoscope to be released
- Helical tissue grasper
- Running and interrupted sutures
- Versatile tool
# Overstich Primary procedure. Results at 1 year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Initial (n=84)</th>
<th>1 month (n=69)</th>
<th>3 months (n=52)</th>
<th>6 months (n=40)</th>
<th>12 months (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>107.3 +17.8</td>
<td>100.0 +16.5</td>
<td>93.8 +16.3</td>
<td>88.0 +15.7</td>
<td>89.3 +14.3</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>37.7 + 4.9</td>
<td>35.2 + 4.4</td>
<td>33.1 + 4.3</td>
<td>31.6 + 4.8</td>
<td>31.3 + 4.9</td>
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<tr>
<td>TBWL (kg)</td>
<td>7.6 + 2.9</td>
<td>13.9 + 5.3</td>
<td>18.6 + 9.5</td>
<td>21.1 + 12.6</td>
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<tr>
<td>%TBWL</td>
<td>7.1+ 2.3</td>
<td>12.8+ 4.1</td>
<td>17.1+ 7.2</td>
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<tr>
<td>%EWL</td>
<td>23.4+ 12.2</td>
<td>41.0+ 16.9</td>
<td>53.6+ 24.5</td>
<td></td>
<td><strong>54.6+ 31.9</strong></td>
</tr>
</tbody>
</table>

9 months postprocedure  
11 months postprocedure  
Endoscopic view at 1 year
Endobarrier

- GI Dynamics
- Bypasses duodenum and proximal jejunum
- 12 month implant
- 7.7% weight reduction after 12 months
- -1.1% HbA1C after 12 months
- U.S. pivotal trial paused due to reports of 4 hepatic abscesses
Fractyl labs

For type II diabetes

Ablation of duodenal mucosa (L cells) implicated in insulin resistance

Thermal (hot water balloon)

Serial treatment

Evaluated treating a long segment (LS) of 9.3 cm vs. a short segment (SS) of 3.4 cm
Duodenal resurfacing

- Proof of Principle Study
- 39 patients
  - 28 received LS
  - 11 received SS
- Baseline A1c = 9.5%
- Hemoglobin A\textsubscript{1C} improvement of 1.2 at 6 months

Rajagopalan H. *Diabetes Care* 2016;Aug 12
Duodenal resurfacing: short vs. long segment results

Weight loss is Negligible

30 patients @ 1 month
24 patients @ 3 months
8 patients @ 6 months
GI windows anastomotic device

- Self assembling octagonal magnets delivered through endoscope
- Reciprocal octagonal pairs for a large caliber permanent bypass of GI tract
- Couple magnets naturally expelled
HbA1c Decreases Through 12 months

Reduction in HbA1c after GI Windows Procedure

Note: 2/4 of the diabetic and 3/3 pre-diabetic patients are out to 12 months

<table>
<thead>
<tr>
<th>HbA1c</th>
<th>Diabetic</th>
<th>Pre-diabetic</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.5%+</td>
<td>5.7-6.4</td>
<td>5.6 or less</td>
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</table>
Magnetic anastomosis vs. duodenal resurfacing vs. endobarrier

Baseline

<table>
<thead>
<tr>
<th></th>
<th>HbA1c</th>
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<tbody>
<tr>
<td>Diabetic</td>
<td>6.5%+</td>
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<tr>
<td>Pre-diabetic</td>
<td>5.7-6.4</td>
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<tr>
<td>Normal</td>
<td>5.6 or less</td>
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Magnetic anastomosis

weight loss over time

Weight Loss - 12 Months

<table>
<thead>
<tr>
<th>Month</th>
<th>% Excess Wgt Loss</th>
<th>% Total Wgt Loss</th>
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<tbody>
<tr>
<td>Month 1</td>
<td>14.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Month 2</td>
<td>19.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Month 3</td>
<td>21.7</td>
<td>8.2</td>
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<tr>
<td>Month 6</td>
<td>28.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Month 9</td>
<td>35.8</td>
<td>13.1</td>
</tr>
<tr>
<td>Month 12</td>
<td>40.2</td>
<td>14.6</td>
</tr>
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</table>
Conclusions

- Obesity is a USA and worldwide epidemic
- Current surgical options effective, but performed on relatively few with obesity
- Complications after bariatric surgery are not uncommon
- Endoscopic therapy is an option for many patients and safer than surgery
- Exact role and type(s) of primary endoscopic therapies have not been determined