Surgical Treatment of Obesity: When and How? The Surgeon’s Perspective

John Morton, MD, MPH, FACS
Director of Bariatric Surgery
Stanford School of Medicine

CODHY 2006
Stanford Bariatric Group

- Open and Laparoscopic Gastric Bypass
- Robotic-Assisted Gastric Bypass
- Laparoscopic Adjustable Gastric Banding
- Adolescent Bariatric Surgery
- Sleeve Gastrectomy
Degrees of Obesity – Body Mass Index

- **NORMAL**: 18.5 – 24.9
- **OVERWGT**: 25 – 29.9
- **OBESE**: 30 – 34.9
- **SEVERE LY OBESE**: 35 – 39.9
- **MORBIDLY OBESE**: ≥ 40

CODHY 2006
BMI and Mortality

Target: Diabetes and Metabolic Syndrome

<table>
<thead>
<tr>
<th>No. of Metabolic Characteristics</th>
<th>CHD</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>HR (95% CI)</td>
</tr>
<tr>
<td>0</td>
<td>695 (10.8%)</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2077 (32.2%)</td>
<td>1.79 (1.11, 2.89)*</td>
</tr>
<tr>
<td>2</td>
<td>1984 (30.8%)</td>
<td>2.25 (1.40, 3.60)†</td>
</tr>
<tr>
<td>3</td>
<td>1339 (20.8%)</td>
<td>3.19 (1.98, 5.12)†</td>
</tr>
<tr>
<td>≥4</td>
<td>352 (5.4%)</td>
<td>3.65 (2.11, 6.33)†</td>
</tr>
</tbody>
</table>

CODHY 2006
Sattar, Circulation, 2003
Target: Inflammation and Metabolic Syndrome

CODHY 2006

Sattar, Circulation, 2003
Target: Obesity, Diabetes and Mortality

The effect of obesity on mortality


<table>
<thead>
<tr>
<th>Body mass index</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese, class I (BMI 30.0 to less than 35.0)</td>
<td>2.82*</td>
<td>2.81*</td>
<td>2.65*</td>
<td>2.63*</td>
<td>2.64*</td>
<td>2.64*</td>
</tr>
<tr>
<td>Overweight (BMI 25.0 to less than 30.0)</td>
<td>1.65*</td>
<td>1.66*</td>
<td>1.63*</td>
<td>1.62*</td>
<td>1.62*</td>
<td>1.63*</td>
</tr>
<tr>
<td>Normal (BMI 18.5 to less than 25.0)</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
<td>Ref.</td>
</tr>
<tr>
<td>Underweight (BMI less than 18.5)</td>
<td>1.02</td>
<td>1.00</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
<td>0.98</td>
</tr>
</tbody>
</table>

CODHY 2006

Cardiovascular Disease Mortality Increased with Metabolic Syndrome

Cardiovascular Disease Mortality

**RR (95% CI), 3.55 (1.98–6.43)**

Cumulative Hazard, %

Follow-up, year

YES

NO

The Obesity Epidemic
A Rapidly Expanding Problem

• Three in five Americans are either overweight or obese
• In the past 20 years, adult obesity has doubled
• 300,000+ premature deaths annually
  – 400,000 deaths/year from smoking, but is decreasing
  – 90,000 deaths/year from colon and breast cancer combined
• 75% of obese children become morbidly obese adults

_The Surgeon General’s Call to Action to Prevent Overweight and Obesity._

CODHY 2006
World Health Organization

Deaths from obesity related problems

2.5 million annual (7,500/day)

222,000 in Europe

300,000 in USA

CODHY 2006
1991 Obesity Trends Among U.S. Adults

CODHY 2006
1992 Obesity Trends Among U.S. Adults

CODHY 2006
1994 Obesity Trends Among U.S. Adults

No Data               <10%              10%-14%               15-19%               ≥20%
1996 Obesity Trends Among U.S. Adults

CODHY 2006
1997 Obesity Trends Among U.S. Adults

No Data               <10%              10%-14%               15-19%               ≥20%

CODHY 2006
1999 Obesity Trends Among U.S. Adults

CODHY 2006
2000 Obesity Trends Among U.S. Adults

CODHY 2006
2001 Obesity Trends Among U.S. Adults

No Data

<10%

10%-14%

15-19%

20-24%

≥25%
Morbid Obesity
Medical Options

• Interventions
  – Diet supervised by Nutritionist
  – Tailored activity plan
  – Behavioral Modification
  – Medications
  – Surgery

CODHY 2006
Morbid Obesity

Behavior modification somewhat helpful

- Medical Wt loss Trials generally short term
  - Avg wt loss of 10 kg at 1 year
- Longer studies demonstrate insufficient wt loss
- Overall, 95 % can’t maintain wt loss
High Attrition Rates of Commercial Weight Reduction Programs
Ghrelin: Biological Cause of Post-Diet Weight Regain
Diet Medications

- **Diethylprion** – pulm hypertension, psychosis
- **Dexfenfluramine** – valv hrt dis, pulm htn
- **Fenfluramine** – valv hrt dis, pulm hypertension
- **Fluoxetin** – diarrhea, seizures, hyponatremia
- **Mazindol** – pulm hypertension, AF, syncope
- **Orlistat** – diarrhea, lowers fat soluble vitamins (K
- **Phentermine** – cardio-pulm effects not excluded
- **Sibutramine** – arrythmias, hypertension

- **ALL Require life-long use**

*CODHY 2006*
Solution!

SURGERY

CODHY 2006
Surgery: First Responder to Public Health Epidemics

- Cancer
- Tuberculosis
- Coronary Disease
- Morbid Obesity
Surgical Referral

CODHY 2006 Lung CA Obese Type II DM
Selection Criteria for Surgical Management

- 1991 NIH Consensus Conference Criteria
- BMI ≥ 40 kg/m² or BMI > 35 kg/m² with co-morbidities
- Failure of nonsurgical methods
- Absence of endocrine disorder causing obesity
- Psychologic stability

CODHY 2006
History- Bariatric Surgery

• Jejunoileal bypass mid 1954
• Gastric bypass Mason mid 1967
• Vertical Banded Gastroplasty, Mason 1982
• Biliopancreatic diversion Scopinaro 1996
• Duodenal Switch
• Lap band 1990
• Laparoscopic gastric bypass 1994

CODHY 2006
Ideal Surgery

- Safe
- Effective
- No FollowUp
- Cheap
- It does not exist!
Surgical Treatment of Obesity

- Lap Band
- Sleeve Gastrectomy
- BPD/DS
- Roux en Y Gastric Bypass (RGB)
Evidence for Choosing Operation

- Few Data
- Difficult to Perform RCT in Surgery
  - Blinding
  - Funding
  - Patients Vote with their feet
- Outcomes Research will be critical in the absence of RCTs
Adjustable Silicon Gastric Banding (ASGB)

- Restrictive
- Adjustable
- 50% EWL @ 1 year
- No anemia, dumping or malabsorption
- Few Technical complications
- Few long-term data
Sleeve Gastrectomy

- New Procedure
- No Malabsorption
- Vitamin Deficiencies
- No adjustments
- EWL 30-80%
- May be converted to Lap-Band or Gastric Bypass

CODHY 2006
Duodenal Switch

- Malabsorptive
- 80% EWL
- Technically Difficult
- Fat Soluble Vitamin Deficiencies
- Reserved for the Super-Obese

CODHY 2006
Gastric Bypass (RGB)

- Restrictive and Malabsorptive
- 75-80% EWL
- Mechanical Problems
- Potential Micronutrient Deficiency
Laparoscopic Gastric Bypass

- Wittgrove/Clarke 1993
- 80% excess wt loss
- Wolfe, RCT, 2001
- Less Wound/Pulmonary Complications
- Less Pain
- Earlier Return to Work

CODHY 2006
Post operative complications

- Leaks
- DVT/Pulmonary embolus
- Acute gastric distension
- GI Bleeding
- Wound problems
- Bowel Obstruction
- Incisional Hernia
- Internal Hernia
- Staple line disruption
- Stomal ulceration
- Stomal stenosis
- Metabolic complications

CODHY 2006
## Stanford Results: University HealthSystem Consortium

<table>
<thead>
<tr>
<th></th>
<th>Stanford</th>
<th>UHC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of Stay-Days</strong></td>
<td>3.2</td>
<td>3.55</td>
</tr>
<tr>
<td><strong>ICU Stay-%</strong></td>
<td>0.8</td>
<td>15.18</td>
</tr>
<tr>
<td><strong>Readmissions-%</strong></td>
<td>0.9</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Complications-%</strong></td>
<td>5.4</td>
<td>10.55</td>
</tr>
<tr>
<td><strong>Mortality-%</strong></td>
<td>0</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Surgery Assessment Criteria

• What are the alternatives?
  – Surgery
• Is it safe?
  – Morbidity and Mortality
• Is it effective?
  – Outcomes
• Is it durable?
  – Long Term Outcomes

CODHY 2006
Is it safe? Mortality

**Table 3. Mortality Analysis for Surgical Procedures**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Early or Time-Unspecified Deaths†</th>
<th>Late Deaths‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controlled Trials</td>
<td>Case Series</td>
</tr>
<tr>
<td></td>
<td>Mortality Rate, %</td>
<td>Studies/Patients, n/n</td>
</tr>
<tr>
<td>RYGB</td>
<td>1.0 (0.5–1.9)</td>
<td>15/907</td>
</tr>
<tr>
<td>VBG</td>
<td>0.2 (0–1.4)§</td>
<td>11/401</td>
</tr>
<tr>
<td>Adjustable gastric banding</td>
<td>0.4 (0.01–2.1)</td>
<td>6/268</td>
</tr>
<tr>
<td>BPD</td>
<td>NR</td>
<td>0/0</td>
</tr>
</tbody>
</table>

* Values in parentheses are 95% CIs unless otherwise indicated. BPD = biliopancreatic diversion; NR = not reported; RYGB = Roux-en-Y gastric bypass; VBG = vertical banded gastroplasty.
† Early = ≤30 days from procedure, or designated “early” in the original report.
‡ Late = >30 days from procedure, or designated “late” in the original report.
§ One-sided 97.5% CI.
Weighing In on Bariatric Surgery
Procedure Use, Readmission Rates, and Mortality

Bruce M. Wolfe, MD
John M. Morton, MD, MPH

In recent years, there has been a dramatic increase in the number of bariatric surgical procedures performed in the United States and worldwide. This increase suggests that the epidemic will worsen before it improves. Furthermore, it is estimated that at least 5% of the adult population in the United States experiences severe obesity, defined as a body mass index (BMI) greater than 40. Second, multiple epidemiologic studies have demonstrated that increasing BMI is a causative factor in many life-threatening conditions, suggesting that surgical intervention may be a potentially life-saving intervention in the right patients and in the right surgeons' hands, they added. The studies presented in this issue indicate that experience and technique count.

CODHY 2006
Nationwide Inpatient Sample
LOS>7 Days
Morton, JACS 2006

This is for all subjects overall

Percent with LOS>7

A_0_49  B_50_124  C_125+

Volume

CODHY 2006
Nationwide Inpatient Sample
Any Complications
Morton, JACS 2006

This is for all subjects overall

CODHY 2006
Nationwide Inpatient Sample Mortality
Morton, JACS 2006

This is for all subjects overall

CODHY 2006
Does It Work?

- Comorbidity Resolution
- Weight Loss
- Survival Benefit
Does It Work? Weight Loss

CODHY 2006

Sjostrom, NEJM, 2004
## Does It Work? Comorbidity Resolution

### Table 8. CHANGE IN OBESITY-RELATED COMORBIDITY

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>Total</th>
<th>% Aggravated</th>
<th>% Unchanged</th>
<th>% Improved</th>
<th>% Resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>OA/DJD</td>
<td>64</td>
<td>2</td>
<td>10</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>GERD</td>
<td>62</td>
<td>0</td>
<td>4</td>
<td>33</td>
<td>63</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>58</td>
<td>0</td>
<td>4</td>
<td>24</td>
<td>72</td>
</tr>
<tr>
<td>Depression</td>
<td>57</td>
<td>0</td>
<td>12</td>
<td>18</td>
<td>70</td>
</tr>
<tr>
<td>Peripheral edema</td>
<td>44</td>
<td>0</td>
<td>5</td>
<td>19</td>
<td>74</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>43</td>
<td>0</td>
<td>14</td>
<td>29</td>
<td>57</td>
</tr>
<tr>
<td>Asthma</td>
<td>36</td>
<td>8</td>
<td>37</td>
<td>47</td>
<td>8</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>31</td>
<td>0</td>
<td>4</td>
<td>55</td>
<td>41</td>
</tr>
<tr>
<td>Migraine headaches</td>
<td>18</td>
<td>0</td>
<td>11</td>
<td>39</td>
<td>44</td>
</tr>
<tr>
<td>Anxiety</td>
<td>18</td>
<td>0</td>
<td>12</td>
<td>69</td>
<td>13</td>
</tr>
<tr>
<td>Venous insufficiency</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>82</td>
</tr>
<tr>
<td>Gout</td>
<td>7</td>
<td>0</td>
<td>14</td>
<td>29</td>
<td>57</td>
</tr>
<tr>
<td>CAD</td>
<td>7</td>
<td>0</td>
<td>50</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>COPD</td>
<td>7</td>
<td>0</td>
<td>71</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>CHF</td>
<td>7</td>
<td>0</td>
<td>14</td>
<td>14</td>
<td>72</td>
</tr>
<tr>
<td>OHS</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>OHS</td>
<td>3</td>
<td>0</td>
<td>33</td>
<td>67</td>
<td>0</td>
</tr>
<tr>
<td>OHS</td>
<td>3</td>
<td>0</td>
<td>33</td>
<td>67</td>
<td>0</td>
</tr>
<tr>
<td>OHS</td>
<td>2</td>
<td>0</td>
<td>33</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

CAD, coronary heart disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; GERD, gastroesophageal reflux disease; HTN, hypertension; OA/DJD, osteoarthritis/degenerative joint disease; OHS, obesity hypoventilation syndrome.
Obesity surgery can lower heart risk

Study: Gastric bypass more effective than statins in cutting cholesterol

Patients who got the surgery showed improved levels of three new measures of heart disease risk -- C-reactive protein, lipoprotein A and homocysteine, the team at Stanford University School of Medicine found. They measured these proteins, as well as cholesterol levels, in 371 patients before surgery and again a year later and found improvements to normal range in all of them.

Updated: 3:05 p.m. ET July 18, 2005
Coronary Artery Disease: Obesity and Smoking

• Primary modifiable CAD risk factors: obesity and smoking
  – While smoking decreases, obesity is increasing (JAMA 05)
  – Rise in obesity may negate gains in life expectancy (NEJM 2005)
Morbid Obesity

• The only effective and enduring long-term therapy is bariatric surgery
• Gastric bypass substantially improves several cardiovascular risk factors:
  – Excess Weight
  – Lack of Exercise
  – Hypertension
  – Diabetes
Methods

Prospective study - August 2003 to March 2005

• No statin therapy post-op
• All with B12 and MVI supplementation
• 371 patients with roux-en-Y gastric bypass
  – 100% laparoscopic
• Cardiac risk factor assessment @ pre-op, 3, 6, and 12 months post-op
  – BMI, HgA1C
  – Total cholesterol, LDL, HDL, triglycerides
  – C-reactive protein, lipoprotein A, homocysteine

CODHY 2006
Biochemical Cardiac Risk Factors

• Traditional Biochemical Risk Factors
  – ↑ LDL
  – ↓ HDL
  – ↑ Total Cholesterol / HDL Ratio
  – ↑ Triglycerides
  – ↑ HgA1C

• However, nearly half of all myocardial infarctions and strokes occur in people with a normal LDL
Emerging Cardiac Risk Factors

- C-Reactive Protein (CRP)
- Lipoprotein A (LipoA)
- Homocysteine (Hcys)
President Bush’s Lipid Panel

- total cholesterol: 178 (<200)
  HDL: 56 (>40)
  Large HDL: 32 (>30)
  LDL: 100 (<130)
- total cholesterol/HDL ratio: 3.2
- Triglycerides: 71 (<150)
- Lipoprotein (a): 17.9 (<30)
- hs-CRP: 0.4 (< 1.0)
- Homocysteine: 9.3 (5-15)
Comparison of Biochemical Risk Factors

- Lipoprotein(a)
- Homocysteine
- Total Cholesterol (TC)
- LDL Cholesterol (LDLC)
- TC:HDLC Ratio
- CRP
- CRP + TC:HDLC Ratio

Relative Risk of Future Cardiovascular Events
## Methods: Study Population

<table>
<thead>
<tr>
<th></th>
<th>Mean (Range) or Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>43 (16-63)</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>47 (35-88)</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>84%</td>
</tr>
<tr>
<td><strong>Hypertensive</strong></td>
<td>50%</td>
</tr>
<tr>
<td><strong>Known CAD</strong></td>
<td>2%</td>
</tr>
<tr>
<td><strong>Diabetic</strong></td>
<td>33%</td>
</tr>
<tr>
<td><strong>Use of Statins</strong></td>
<td>23%</td>
</tr>
</tbody>
</table>

*CODHY 2006*
Cardiovascular Risk Markers: Percent Abnormal Pre-op

CODHY 2006
Improvement in Cardiac Risk Factors: Total Cholesterol

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: LDL

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: HDL

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Triglycerides

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Total Cholesterol/HDL

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Hemoglobin A1C

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Homocysteine

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Lipoprotein A

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: High Sensitivity C Reactive Protein

CODHY 2006

Morton, SOARD, 2006
Improvement in Cardiac Risk Factors: Triglycerides/HDL

CODHY 2006

Morton, SOARD, 2006
Percent Improvement in Cardiac Risk: 1 year S/P Gastric Bypass

CODHY 2006

Morton, SOARD, 2006
Conclusion

• Morbidly obese patients have significantly elevated cardiovascular risk
• Emerging cardiac risk factors may assist in cardiac risk stratification
• Gastric bypass substantially improves the traditional and emerging biochemical risk factors for cardiovascular disease
• Gastric Bypass Reduced CRP 80%
# Does It Work? Survival Benefit

## TABLE 4. Five-Year Morbidity and Mortality

<table>
<thead>
<tr>
<th>Condition/disease</th>
<th>Bariatric Surgery</th>
<th>Controls</th>
<th>Relative Risk Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Blood and blood-forming organs</td>
<td>4</td>
<td>0.39</td>
<td>41</td>
</tr>
<tr>
<td>Cancer</td>
<td>21</td>
<td>2.03</td>
<td>487</td>
</tr>
<tr>
<td>Cardiovascular and circulatory</td>
<td>49</td>
<td>4.73</td>
<td>1530</td>
</tr>
<tr>
<td>Digestive</td>
<td>377</td>
<td>36.43</td>
<td>1414</td>
</tr>
<tr>
<td>Endocrinological</td>
<td>98</td>
<td>9.47</td>
<td>1566</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>77</td>
<td>7.44</td>
<td>551</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>90</td>
<td>8.70</td>
<td>2140</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>50</td>
<td>4.83</td>
<td>682</td>
</tr>
<tr>
<td>Nervous system</td>
<td>25</td>
<td>2.42</td>
<td>228</td>
</tr>
<tr>
<td>Psychiatric and mental</td>
<td>45</td>
<td>4.35</td>
<td>470</td>
</tr>
<tr>
<td>Respiratory</td>
<td>28</td>
<td>2.71</td>
<td>651</td>
</tr>
<tr>
<td>Skin</td>
<td>38</td>
<td>3.67</td>
<td>305</td>
</tr>
<tr>
<td>Mortality</td>
<td>7</td>
<td>0.68</td>
<td>354</td>
</tr>
</tbody>
</table>

CODHY 2006

Christou, Ann Surg, 2004
Is it Durable?

• Pories- Ann Surg 1995
  – 14 year Follow Up
  – 304 lbs to 205 lbs, year 14
  – At year 14, 83% resolution of DM

• Sugerman- Ann Surg 2003
  – 7 year Follow up
  – BMI Decrease from 51 to 35
  – 86% resolution of DM, 66% resolution of HTN

CODHY 2006
Cost-effectiveness: QALY < 50K

CODHY 2006
Long Term Outcomes and Follow Up for Bariatric Surgery

- ONLY effective and enduring weight loss therapy for morbidly obese
- Safe
- Effective
- Durable
- Cost-Effective
Stanford Bariatric Surgery AfterCare

• 2 weeks, 6 weeks, 3 months, 6 months, 1 year, Once a Year
• Re-Referral to PT, Nutrition, Psych
• Education = Prevention
  – Chronic Disease Management
Summary

• Surgery requires careful patient selection and education
• Surgery is a TOOL, not a cure
• Long term commitment with healthcare team
• Potential for gain outweighs risks of operation
• Many problems cured through surgical management of obesity
Testimonial

• 3 years S/P LRNYGB
• 75% Excess Wgt Loss
• Complete Resolution
  – IDDM
  – OSA
  – HTN

CODHY 2006