Current Bariatric & Metabolic Surgery

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Department of Surgery,
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The Catholic University of Korea
• Global Burden of in Morbid obese & Metabolic syndrome

• Basic concepts
  Several bariatric procedures & GI Hormones

• Mechanisms of Surgical Control of Diabetes
  Caloric Intake/Weight loss
  The role of incretin
  Ileal break
  Upper intestinal hypothesis
  Animal and Surgical Models
Global Burden of in Morbid obese & Metabolic syndrome

- Major public health problem worldwide
- Affects 25% of industrialized world
- American statistics:
  - 55% (34 Million) adults are overweight (BMI > 25)
  - 25% of children are overweight
  - 5-11 million are morbidly obese
  - 6% of health care expenditures ($238 Billion / year)
  - 300,000 deaths annually
Obesity in Korea: Epidemiology
(Korea National Health and Nutrition Examination Survey III, 1995-2005)

- Prevalence of obesity in adults: 32.4%
- Prevalence of obesity in children: 10.2%
- Prevalence of obesity in adolescents: 18%
- Socioeconomic burden associated with obesity: 4.9% of total health care expenditure

Obesity (BMI >25 kg/m²) in Korean adults
Treatment of Obesity

Medical treatment ineffective BMI>35
Medical treatment ineffective >10kg WL
1992 NIH consensus
  - Surgery the only effective method of sustainable weight loss
    - BMI>40
    - BMI>35 with associated co-morbidities
for Asian

1) obese patients with their BMI>37
2) obese patients with their BMI>32 in the presence of diabetes or two significant obesity related comorbidities
3) have been unable to lose or maintain weight loss by dietary or medical measures
4) age of patient > 18 years and < 65 years

2005 Asia Pacific Bariatric Surgery Group (APBSG)
Number of bariatric surgery performed in Korea is not enough to satisfy the requirement of obese population from 2003 to present

Misconception

Patient & doctor’s education

Insurance reimbursement
Medical Complications of Obesity

- Pulmonary disease
  - Abnormal function
  - Obstructive sleep apnea
  - Hypoventilation syndrome

- Idiopathic intracranial hypertension

- Stroke
  - Cataracts

- Nonalcoholic fatty liver disease
  - Steatosis
  - Steatohepatitis
  - Cirrhosis

- Gall bladder disease

- Gynecologic abnormalities
  - Abnormal menses
  - Infertility
  - Polycystic ovarian syndrome

- Osteoarthritis

- Skin

- Gout

- Coronary heart disease
  - Diabetes
  - Dyslipidemia
  - Hypertension

- Severe pancreatitis

- Cancer
  - Breast, uterus, cervix
  - Colon, esophagus, pancreas, kidney, prostate

- Phlebitis
  - Venous stasis
Obesity

- major independent risk factor of the development & the prevalence of Type 2 DM

- total of 80% of individuals with Type 2 DM are obese (30% in Korean) and 50% are morbid obese

Bloomgarden ZT Diabetes Care 2000
Central Obesity and Free Fatty Acids

- Increased Constriction
- Decreased Relaxation
- Vasculature

Upper body + visceral obesity

- Increased FFA
- Insulin Resistance
- Decreased Glucose Uptake
- Muscle
- Liver
- Pancreas
- Increased Insulin Secretion
- Glucose Release
- TG
Basic concepts

- Several bariatric & metabolic surgery procedures
- GI Hormone
Several operative procedures are performed for treatment of morbid obesity

Bariatric Surgery

- Restrictive
- Mixed
- Malabsorptive
Factors that may play a role in decision-making process

- Age
- Medical History
- Surgical History
- BMI
- Psychological Profile
- Nutritional Profile
- Lifestyle
- Personal choice
# Comparison

<table>
<thead>
<tr>
<th></th>
<th>Gastric Bypass</th>
<th>Lap Band</th>
<th>Duodenal Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>1-4 hours</td>
<td>0.5-2 hours</td>
<td>2-5 hours</td>
</tr>
<tr>
<td><strong>LOS</strong></td>
<td>2-3 days</td>
<td>1-2 days</td>
<td>3-4 days</td>
</tr>
<tr>
<td><strong>Supplements</strong></td>
<td>MVI, Fe, Ca</td>
<td>MVI, Ca</td>
<td>All, + ADEK</td>
</tr>
<tr>
<td><strong>Weight loss</strong></td>
<td>50-75% EBW</td>
<td>40-50% EBW</td>
<td>60-80% EBW</td>
</tr>
<tr>
<td><strong>Side effects</strong></td>
<td>Dumping</td>
<td>Vomiting</td>
<td>Diarrhea, odor</td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td>0-1%</td>
<td>0-1%</td>
<td>0.5-2.5%</td>
</tr>
<tr>
<td><strong>Short-term</strong></td>
<td>DVT, leak, infection, bleed</td>
<td>DVT, infection, perforation</td>
<td>DVT, leak, infection, bleed</td>
</tr>
<tr>
<td><strong>complications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Long-term</strong></td>
<td>Stenosis, ulcer, vitamin def</td>
<td>Slip, erosion, dilation</td>
<td>Malnutrition, revision</td>
</tr>
<tr>
<td><strong>complications</strong></td>
<td></td>
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</tr>
</tbody>
</table>
Laparoscopic Sleeve Gastrectomy

- **Restrictive**
- Reduction of the size of the stomach, to about 100 - 120 cc in volume
- Preserves the pylorus, acts as "natures band"
- 45 to 55% EWL
- Need long term follow-up
Vertical banded gastroplasty

Minigastric bypass
Bariatric Instruments
As stated clearly in the SAGES & ASBMS guidelines: for surgical treatment of Morbid Obesity: the **multidisciplinary approach** includes medical management of co-morbidities, dietary instruction, exercise training, specialized nursing care & psychological assistance as needed.
Total Bariatric cases from April 2006-Sep 2007
Data was reported at ACS 2008 (SLRHC)

<table>
<thead>
<tr>
<th></th>
<th>LRYGBP (N=345, 79.3%)</th>
<th>LAGB (N=90, 20.7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (yr)</td>
<td>39</td>
<td>45</td>
</tr>
<tr>
<td>Men BMI (kg/m²)</td>
<td>50</td>
<td>46</td>
</tr>
<tr>
<td>Female: Male</td>
<td>305:40</td>
<td>77:13</td>
</tr>
<tr>
<td>Mean %EWL at 6 months</td>
<td>64%</td>
<td>28%</td>
</tr>
<tr>
<td>Post op complications</td>
<td>30 cases (8.6%)</td>
<td>3 cases (3.3%)</td>
</tr>
<tr>
<td></td>
<td>leak 3, stricture 7,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>adhesion 2, SBO 6,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>marginal ulcer 1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bleeding 1, uterine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bleeding 1, UTI 1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DVT 1, pleural</td>
<td></td>
</tr>
<tr>
<td></td>
<td>effusion 1, malnutrition 1, GE 2,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>subphrenic abscess 1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dehydration 1</td>
<td></td>
</tr>
<tr>
<td>Readmission rate</td>
<td>26 cases (7.5%)</td>
<td>1 case (1.1%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Initial evaluation of Laparoscopic Roux-en-Y Gastric Bypass and Adjustable Gastric banding in Korea: a single institution study

Hongchan Lee, M.D., Dohyoung Kim, M.D., Sangkuon Lee, M.D., Namkwan Woo, M.D., Eungkook Kim, M.D.

1 Division of Laparoscopic & Bariatric Surgery, Department of Surgery St. Mary’s Hospital, College of Medicine
2 Division of Gastroenterology, Department of Internal Medicine Kang Nam St. Mary’s Hospital, College of Medicine
The Catholic University of Korea Seoul, Korea
Patients characteristics (Mean ± SD) of Korean 84 bariatric cases

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>LRYGBP (N=31)</th>
<th>LAGB(N=53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender M / F(%)</td>
<td>6 / 25 (12% / 88%)</td>
<td>17 / 36(31% / 69%)</td>
</tr>
<tr>
<td>Mean Age (year)</td>
<td>29 ± 8</td>
<td>33 ± 12</td>
</tr>
<tr>
<td>Body Weight(kg)</td>
<td>110.3 ± 16.2</td>
<td>113.1 ± 25.5</td>
</tr>
<tr>
<td>Height(m)</td>
<td>1.64 ± 0.07</td>
<td>1.68 ± 0.10</td>
</tr>
<tr>
<td>BMI(kg/m²)</td>
<td>41 ± 5</td>
<td>40 ± 8</td>
</tr>
</tbody>
</table>
### Pre-operative comorbidities of 84 Bariatric patients

<table>
<thead>
<tr>
<th>Patient number of pre-existing comorbidities</th>
<th>LRYGBP N=31</th>
<th>LAGB N=53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyslipidemia</td>
<td>9(29%)</td>
<td>8(15%)</td>
</tr>
<tr>
<td>Sleep apnea</td>
<td>8(26%)</td>
<td>12(23%)</td>
</tr>
<tr>
<td>GERD</td>
<td>9(29%)</td>
<td>13(25%)</td>
</tr>
<tr>
<td>DJD</td>
<td>8(26%)</td>
<td>17(33%)</td>
</tr>
<tr>
<td>DM</td>
<td>9(29%)</td>
<td>12(23%)</td>
</tr>
<tr>
<td>HTN</td>
<td>10(32%)</td>
<td>16(30%)</td>
</tr>
</tbody>
</table>
### Post-operative complications and management in LRYGBP

<table>
<thead>
<tr>
<th></th>
<th>LRYGBP (N=31,%)</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anastomosis site leak(GJ)</td>
<td>3(9%)</td>
<td>- GJ leak; open exploration on POD#1 day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 2 Esophageal leak on POD#1 day, stopped on 1 and 2 months</td>
</tr>
<tr>
<td>Small Bowel Obstruction</td>
<td>1(3%)</td>
<td>- Roux limb obstruction, Lap. Revision</td>
</tr>
<tr>
<td>Internal herniation</td>
<td>1(3%)</td>
<td>- Petersen’s herniation (SBstrangulation) on POD#3 weeks, massive bowel resection and gastrogastric anastomosis (restoration of Continuity)</td>
</tr>
<tr>
<td>Incisional herniation</td>
<td>1(3%)</td>
<td>- Conservative treatment</td>
</tr>
<tr>
<td>Anastomosis site bleeding</td>
<td>1(3%)</td>
<td>- J-J bleeding with obstructing hematoma &amp; GJ leak on POD#1 day, open exploration and repair</td>
</tr>
<tr>
<td>Overall morbidity</td>
<td>7(22%)</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>0(0%)</td>
<td></td>
</tr>
</tbody>
</table>
Post operative complications and management in LAGB

<table>
<thead>
<tr>
<th>Condition</th>
<th>LAGB (N=53,%)</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophageal dilatation</td>
<td>1 (1%)</td>
<td>conservative treatment</td>
</tr>
<tr>
<td>Port malposition</td>
<td>2 (1%)</td>
<td>access port relocated in left upper quadrant under general anesthesia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>access port flipping, conservative treatment</td>
</tr>
<tr>
<td>Port site infection</td>
<td>1 (1%)</td>
<td>removal and access port relocated on left subcostal area</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1 (1%)</td>
<td>conservative treatment</td>
</tr>
<tr>
<td>Overall morbidity</td>
<td>5 (9%)</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>0 (0%)</td>
<td></td>
</tr>
</tbody>
</table>
### Percent (%) of excess weight loss (EWL) between two procedures

<table>
<thead>
<tr>
<th></th>
<th>LRYGBP (n=31)</th>
<th>LAGB (n=53)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>68.2 ± 18.7</td>
<td>32.7 ± 13.1</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>12 months</td>
<td>76.9 ± 19.0</td>
<td>46.8 ± 21.0</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>24 months</td>
<td>79.7 ± 18.2</td>
<td>55.1 ± 19.7</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>36 months</td>
<td>85.8 ± 18.6</td>
<td>63.3 ± 18.4</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

### Follow-up of fasting blood glucose and HbA1C level after two procedures

<table>
<thead>
<tr>
<th></th>
<th>LRYGBP (n=7/31)</th>
<th>LAGB (n=12/53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of preop DM (years)</td>
<td>6.4 ± 6.4</td>
<td>3.5 ± 3.2</td>
</tr>
<tr>
<td>Preop Bld Glc level (mg/dl)</td>
<td>220.1 ± 41.1</td>
<td>204.1 ± 21.9</td>
</tr>
<tr>
<td>Postop Bld Glc level (mg/dl at 1 month after procedure)</td>
<td>*72.7 ± 16.4</td>
<td>*101.3 ± 21.2</td>
</tr>
<tr>
<td>Preop HbA1C (%)</td>
<td>9.6 ± 2.1</td>
<td>9.4 ± 1.3</td>
</tr>
<tr>
<td>Postop HbA1C at 1 month (%)</td>
<td>*5.7 ± 2.0</td>
<td>*5.5 ± 1.2</td>
</tr>
</tbody>
</table>

* : significant different between pre and post op level
Roux-en-Y Gastric Bypass

121.8 kg
10 months later
72 kg
14 months later
66.8 kg
EWL 94%
Laparoscopic Adjustable Gastric Banding

134.8 kg

27 months later

69 kg
EWL 87%
Laparoscopic Adjustable Gastric Banding

22 months later

214.5 kg

89 kg
EWL 91%
Minimal-scar LAGB

After conventional access port insertion method.

After “Minimal-scar LAGB”
GastroIntestinal Hormones?
GI Hormones

Molecular Physiology of Weight Regulation

“secretin” was first used to define factors regulating pancreas secretion

“incretin” was later introduced in the 1920’s to describe these potential mediators

The connection between the gastrointestinal tract and the endocrine pancreas was confirmed in the 1960s, when insulin became measurable in plasma.
GI Hormone

- In humans, two peptide hormones have been identified as being responsible for the incretin effect
- Glucose dependent Insulin releasing Polypeptide (GIP, formerly called gastric inhibitory polypeptide) and Glucagon-Like Peptide-1 (GLP-1)

- GIP and GLP-1 are both secreted in response to food ingestion and both potentiate the glucose induced insulin response.
Incretins: GIP & GLP-1

GIP & GLP-1 in T2 DM

<table>
<thead>
<tr>
<th></th>
<th>GIP</th>
<th>GLP-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secretion</td>
<td>Normal</td>
<td>↓</td>
</tr>
<tr>
<td>Response</td>
<td>↓</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Insulin & Glucose Metabolism

GLP-1
Modes of Action

- Stimulates insulin secretion
- Suppresses glucagon secretion
- Slows gastric emptying
- Reduces food intake
- Increases β cell mass and maintains β cell function
- Improves insulin sensitivity
- Enhances glucose disposal

Upon ingestion of food...

GLP-1 is secreted from L cells in the intestine
Incretins: GIP & GLP-1

Biological actions of the incretins (GIP & GLP-1) and therapeutic perspectives in patients with type 2 diabetes

*Diabetes Med 2005: 31; 233-242*
Incretins: GLP-1
(Exenatide®)

Peptide Tyrosine Tyrosine (PYY)

- 36 amino acid
- Straight chain polypeptide
- Member of NPY family
- Acts primarily through Y2 receptor
- L-type endocrine cells
- Co-localized with GLP-1
- Released by: glucose, fatty acids & bile salts
PYY

Actions
- Inhibits cAMP mediated actions
  - Gastric acid secretion
  - Gastric pepsinogen secretion
  - Gastric emptying
  - Small bowel motility (ileal brake mechanism)
  - VIP stimulated cl- secretion
- Inhibits NPY in Arcuate Nucleus
  - Cause satiety
  - Decreases food intake
Clinical
- Decreased levels in obesity
  fasting & postprandial PYY levels are depressed in obese subjects though tissue levels are elevated
- No “PYY Resistance” in obesity
  infusion in obese patients at physiological levels quenches appetite & cause weight loss
- Increased fasting levels & peak postprandial levels after LRYGBP & BPD
Ghrelin

Appetite Stimulant
- Ligand of Growth Hormone Receptor
- Gut peptide
- Found in Stomach & Duodenum (X/A like cell)
- Increases before meals
- Weight loss increase Ghrelin
Ghrelin

Actions
- Decreased insulin release
- Decreased energy expenditure
- Increased appetite
- Increased Growth hormone secretion
- Increased acid secretion & gastric motility
- Increased sleep & memory

T Akamizu & K Kangawa. Endocr J. 2006 Jul 28
Mechanisms of Surgical Control of Diabetes

• Caloric Intake/Weight loss
• The role of incretin
• The role of the forgut
• The role of the hindgut
• Animal and Surgical Models
DE. Cummings, et al

- a meta-analysis of 22,094 patients of RYGBP

- 83% to 86% remission of DM
  normalized blood glucose & HgA1C
  after discontinuation of all DM medication
**Weight loss effect**

- Improving glucose homeostasis-physiologic change
  - increases in muscle insulin receptor density & adiponectin levels
  - decrease in the intramuscular & intrahepatic content of total lipids and long-chain fatty acyl-CoA molecules

- Many months to years after RYGBP
Most dramatic observation
Complete remission of DM within days to weeks after RYGBP

Key role
“ileal brake”

GLP-1, PYY, oxyntomulbin in response to ingested nutrients,

decreased food intake,

decreased UGI motility
“Upper Intestinal hypothesis”

Marked accentuate GLP-1, PYY

- accentuating glucose-dependent insulin secretion, increasing β cell mass and heightening insulin sensitivity

improve glucose homeostasis (greater impact on DM than medical; GLP-1 agonist such as exenatide)
Metabolic Surgery

Glucose and Fat Ingestion

Anti-incretin factor/s

Incretins (GIP, GLP-1, IGF-1, etc.)

Early insulin secretion

Insulin action
Metabolic Surgery

A. Type 2 Diabetes
- Delayed insulin response
- Impaired insulin action

B. Diagram showing
- Cells producing incretins (ileum, duodenum, jejunum)
- Cells producing the unknown factor with anti-incretin effect

Hyperinsulinemia
Metabolic Surgery

Possible mechanisms of action:
1- avoidance of stimulization of cells producing the unknown factor with anti-incretin effect
2- earlier and/or increased GLP-1 production

GLP-1 and other hormones

Improved insulin response and action

Normalization of plasma insulin and glucose

Anti-incretin factor
Changes in Regulatory Peptides

- Decreased Ghrelin
- Increased PYY
- Increased GLP-1
- Decreased Leptin
- Decreased Leptin resistance
- Decreased Insulin
- Decreased Insulin Resistance
Surg Obes Relat Dis. 2007;3(2):195-197

Ricardo V. Cohen, Francesco Rubino et al.

Ileal Trasposition, Sleeve Gastrectomy + Entrectomy, Omentectomy, Intraluminal Duodenal Sleeve
Conclusions

- Bariatric & Metabolic Surgery produce maintaining of weight loss & durable remission of Type 2 DM
- Reduce the mortality from the disease & reduce health care costs
- Not just bariatric surgeons but also metabolic surgeons
Division of Laparoscopic & Bariatric Surgery
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Thank you!