36-year-old woman with DM1 undergoing bariatric surgery

Sharon H. Chou, MD
Endorama
11/21/13
36 yo female nurse with DM1 x 24 years was admitted for sleeve gastrectomy and laparoscopic cholecystectomy.
Past Medical History

- Diabetes mellitus type 1:
  - Insulin pump x 3 months
    - Basal rate: 0.8 units/hr
    - I:C ratio 1:10
    - ISF 50 with goal of 120
  - Reports fasting glucose of ~120, before lunch and dinner in the 130s.
  - Mild hypoglycemic episodes <1x/wk, usually in the morning since starting the preop diet.
  - Peripheral neuropathy symptoms; no known retinopathy; no microalbuminuria.
  - Previously tried Bydureon and metformin in the past.
Past Medical History

- Obesity (BMI 36.5)
- Osteoarthritis of both hips
- Obstructive sleep apnea
- Hypothyroidism
- Anxiety/Depression

Medications:
- Novolog
- Levothyroxine 175 mcg daily
- Paroxetine 20 mg daily
- Multivitamin
- Vitamin B complex
- Calcium and vitamin D supplement
History cont.

- Social history:
  - RN here.
  - 5 children.
  - No tobacco use.

- Family history:
  - Daughter with DM1.
  - Mother with hypothyroidism.
  - 2 sons with ADHD

- Review of Systems:
  - Weight loss of 10 lbs on preop diet
  - + nausea, no vomiting, abdominal pain controlled
  - + peripheral neuropathy
  - + anxiety
Physical Exam

- BP 106/58 | Pulse 103 | Temp 96.8 °F (Tympanic) | Resp 16 | Ht 154.9 cm (5' 1") | Wt 87.635 kg (193 lb 3.2 oz) | BMI 36.50 kg/m2 | SpO2 99%
- Constitutional: Patient appears well-developed, well-nourished, in no acute distress.
- Eyes: Conjunctivae are not injected. Sclerae anicteric. Pupils are equal, round, and reactive to light. Extraocular movements are intact.
- ENT: Mucous membranes moist.
- Neck: Supple. No thyromegaly or nodules palpated.
- Cardiovascular: Regular rhythm and rate. No murmurs appreciated. Intact distal pulses.
- Respiratory/Chest: Normal respiratory effort. No wheezes or crackles.
- Gastrointestinal/Abdomen: + bowel sounds. Soft, diffusely tender, nondistended.
- Musculoskeletal/extremities: No peripheral edema.
- Neurological: Alert and oriented to person, place, and date. Normal deep tendon reflexes.
- Skin: Skin is warm and dry. No acanthosis.
- Psychiatric: Normal mood and affect.
## Laboratory Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total protein</td>
<td>6.8</td>
<td>Alb 4.3</td>
<td>total bilirubin 0.3</td>
<td>alk phos 71</td>
</tr>
<tr>
<td>AST</td>
<td>13</td>
<td>ALT 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1c</td>
<td>8.9%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

256

4.4 25 0.7 261
Questions:

- What are the mechanisms behind the immediate effects of bariatric surgery on type 2 diabetes?
- Is there any suggestion that these immediate effects would apply to type 1 diabetes?
Rates of DM2 Improvement after Bariatric Surgery

- **Restrictive**
  - AGB: 44%
  - VSG: 55%

- **Restrictive & Malabsorptive**
  - RYGB: 83%
  - BPD-DS: 94%

Hypotheses for immediate glycemic effects

- Caloric restriction hypothesis
  - Fails to explain why improvements in glycemia control occur much faster after RYGB than AGB.

- Malabsorption hypothesis
  - Only fat absorption decreased after RYGB and malabsorption accounted for only 6% of the total reduction in energy absorption at 5 months.

Hypotheses for immediate glycemic effects

- **Ghrelin hypothesis:**
  - Ghrelin is produced by the fundus of the stomach and stimulates appetite/food intake and suppresses glucose-induced insulin secretion.
  - Preprandial ghrelin levels are low after bariatric surgery.

- **Hindgut hypothesis:**
  - Expedited delivery of nutrients to the lower bowel increases GLP-1 release from intestinal cells.
  - Up to 10-fold increase in area-under-curve value for GLP-1 has been reported 1 week after RYGB.

- **Foregut hypothesis:**
  - Exclusion of duodenal contact with ingested nutrients has a direct effect (unknown mechanism).

Hypotheses for immediate glycemic effects

- Gut microbiota hypothesis
- Branched-chain amino acids hypothesis

Immediate Effects in Sleeve Gastrectomy

Case report for Type 1 Diabetes

<table>
<thead>
<tr>
<th>Patient</th>
<th>Years of DM1</th>
<th>Operation</th>
<th>BMI</th>
<th>A1c</th>
<th>Insulin u/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt A</td>
<td>18</td>
<td>RYGB</td>
<td>43.9</td>
<td>6.7</td>
<td>0.54</td>
</tr>
<tr>
<td>33F</td>
<td>4 wks</td>
<td>38.0</td>
<td></td>
<td></td>
<td>0.22</td>
</tr>
<tr>
<td>Pt B</td>
<td>19</td>
<td>SG</td>
<td>37.3</td>
<td>7.4</td>
<td>0.72</td>
</tr>
<tr>
<td>38F</td>
<td>4 wks</td>
<td>33.3</td>
<td>6.5</td>
<td></td>
<td>0.41</td>
</tr>
</tbody>
</table>

GLP-1 Use in Type 1 Diabetes

- **Acute Effects:**
  - Decreased glucose excursion by 33% during mixed meal test.
  - Suppresses glucagon levels.
  - Delays gastric emptying.
  - Does not change insulin secretion rate.

- **Longer Term Effects (4 weeks):**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>C-peptide positive</th>
<th>C-peptide negative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 0</td>
<td>Week 4</td>
</tr>
<tr>
<td>Insulin dose (units/kg per day)</td>
<td>0.50 ± 0.06</td>
<td>0.31 ± 0.08*</td>
</tr>
<tr>
<td>Mean blood glucose (mmol/L)</td>
<td>6.0 ± 0.2</td>
<td>6.3 ± 0.3 (NS)</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>6.6 ± 0.3</td>
<td>6.4 ± 0.2†</td>
</tr>
<tr>
<td>C-peptide (pmol/L)</td>
<td>520 ± 106</td>
<td>457 ± 79 (NS)</td>
</tr>
</tbody>
</table>

Follow up

Surgery:
- 2 weeks
  - 202 lbs → 184 lbs
  - Meal size 10% of pre-op
  - Appetite decreased, increased satiety
  - Loose stools
- 2 months
  - 172 lbs
  - Meal size 20% of pre-op
  - Nausea req. Zofran

Endocrine:
- 2.5 months
  - A1c 8.0% (from 8.9%)
  - Frequent hypoglycemia in the last 2 weeks.
  - Decreased basal to 0.6, I:C 1:15.
- 3 months
  - 163 lbs
  - BMI: 30
  - Mild nausea
References

Ghrelin and Type 1 Diabetes

- Use of ghrelin agonists being studied for diabetic gastroparesis
- Shin et al: 10 patients with DM1, avg age of 46, avg BMI 24, avg duration of DM1 of 32 years, avg HgbA1c 9.1%.
  - Faster solid gastric emptying of 34 min.
  - Avg blood glucose at 120 min. were 248 v. 231, NS.

## Case series

<table>
<thead>
<tr>
<th>Pt</th>
<th>Yrs of DM1</th>
<th>Surgery</th>
<th>BMI</th>
<th>A1c</th>
<th>Insulin IU/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23F</td>
<td>8 yrs</td>
<td>RYGB 8 yrs</td>
<td>38.8</td>
<td>9.5%</td>
<td>6.9%</td>
</tr>
<tr>
<td>28F</td>
<td>23 yrs</td>
<td>RYGB 6 yrs</td>
<td>46.3</td>
<td>10.4-11.8%</td>
<td>7.5%</td>
</tr>
<tr>
<td>19M</td>
<td>4 yrs</td>
<td>RYGB 5 yrs</td>
<td>41.5</td>
<td>10.5%</td>
<td>6.8%</td>
</tr>
<tr>
<td>29F</td>
<td>8 yrs</td>
<td>RYGB 12 mo</td>
<td>40.6</td>
<td>8.2%</td>
<td>7.5%</td>
</tr>
<tr>
<td>62F</td>
<td>53 yrs</td>
<td>RYGB 12 mo</td>
<td>43.9</td>
<td>7.6%</td>
<td>7.8%</td>
</tr>
<tr>
<td>36F</td>
<td>14 yrs</td>
<td>RYGB 12 mo</td>
<td>53.2</td>
<td>8.1%</td>
<td>8.8%</td>
</tr>
<tr>
<td>38F</td>
<td>19 yrs</td>
<td>SG 12 mo</td>
<td>37.3</td>
<td>7.4%</td>
<td>7.2%</td>
</tr>
<tr>
<td>43F</td>
<td>8 yrs</td>
<td>BPD-DS 12 mo</td>
<td>43</td>
<td>9.8%</td>
<td>6.4%</td>
</tr>
<tr>
<td>46F</td>
<td>12 yrs</td>
<td>BPD-DS 12 mo</td>
<td>46</td>
<td>8.7%</td>
<td>5.7%</td>
</tr>
<tr>
<td>42F</td>
<td>25 yrs</td>
<td>BPD-DS 12 mo</td>
<td>42</td>
<td>7.9%</td>
<td>8.5%</td>
</tr>
</tbody>
</table>