Bariatric surgery: 
*Putting HbA1c in its place and much more*

CHARLES J. KEITH, JR. MD  
ASSISTANT PROFESSOR OF SURGERY  
UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT TYLER

What best represents your opinion of bariatric surgery?

A. Its voodoo  
B. The only benefit is weight loss  
C. It’s a cosmetic procedure  
D. It’s the easy way out  
E. It’s not worth the risk  
F. It’s the best treatment for long-term T2DM improvement/remission
Key Points

- The best tool for obtaining glycemic control in patients with obesity and T2DM
- Excellent reduction in adverse cardiovascular events after surgery
- Bariatric surgery is safe!
- If your patient has T2DM, think bariatric surgery referral...They will thank you!
Obesity Trends* Among U.S. Adults
BRFSS, 1985

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)

<table>
<thead>
<tr>
<th>Region</th>
<th>No Data</th>
<th>&lt;10%</th>
<th>10%–14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Obesity Trends* Among U.S. Adults
BRFSS, 1990

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)

<table>
<thead>
<tr>
<th>Region</th>
<th>No Data</th>
<th>&lt;10%</th>
<th>10%–14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Obesity Trends* Among U.S. Adults
BRFSS, 1990

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)

<table>
<thead>
<tr>
<th>Region</th>
<th>No Data</th>
<th>&lt;10%</th>
<th>10%–14%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Obesity Trends* Among U.S. Adults
BRFSS, 1995

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)

No Data           <10%          10%–14% 15%–19%

Obesity Trends* Among U.S. Adults
BRFSS, 2000

(*BMI ≥ 30, or ~ 30 lbs. overweight for 5’ 4” person)

No Data          <10%           10%–14% 15%–19% ≥20%
Obesity Trends* Among U.S. Adults
BRFSS, 2005
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Obesity Trends* Among U.S. Adults
BRFSS, 2010
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Prevalence\textsuperscript{\textdagger} of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2011

\textsuperscript{\textdagger} Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) \(\geq 30\%\).

Prevalence\textsuperscript{\textdagger} of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2012

\textsuperscript{\textdagger} Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) \(\geq 30\%\).
Prevalence\(^\dagger\) of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2013

\(^\dagger\) Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.

Prevalence\(^\dagger\) of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2014

\(^\dagger\) Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2015

Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.

Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2016

Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Prevalence\(^\circ\) of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2017

\(^1\) Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.

Prevalence\(^\circ\) of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2018

\(^1\) Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

*Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.
Why is this a problem?

Numerous health risks associated with obesity
- Cardiovascular disease
- Hypertension
- Hyperlipidemia
- MI
- Heart failure
- Stroke
- Diabetes
- Obstructive sleep apnea
- Kidney disease
- Cancers
- Chronic joint pains/immobility
- PCOS & Infertility
- Migraines/Pseudotumor cerebri

GERD/reflux
- Fatty liver > cirrhosis
- Depression
- Asthma/Reactive airway disease
- Pre-mature death

Why is this a problem?

Large economic burden of obesity
- 7.9% of US medical expenditures in adults (2015)
  - Increase of 29% since 2001
- Obesity is associated with lower wages & probability of employment
Why surgery?

Diabetes (T2DM)
Key points

- Surgery + medical management SUPERIOR to medical management alone for obtaining glycemic control
  - STAMPEDE Trial

- Surgery decreases major adverse cardiovascular outcomes in patients with obesity and diabetes

Impaired glucose homeostasis

- Insulin resistance + defective pancreatic beta cell function
  - Worsens with time

- T2DM ensues when beta cells become incapable of releasing sufficient insulin to compensate for peripheral insulin resistance
Surgery for Diabetes?

Who Would Have Thought It?
An Operation Proves to Be the Most Effective Therapy for Adult-Onset Diabetes Mellitus

- 608 patients over 14 years
- Gastric bypass
- Durable weight loss
- Normalized glucose levels, A1c, and insulin use
  - 99% w/ pre-DM
  - 83% w/ T2DM
Blood glucose & insulin requirements fall drastically just days after gastric bypass!!

- Decreased caloric intake?
- Bypassed foregut?
- Increased incretins from hindgut?
- Does it prevent T2DM complications?
  - Underpowered
How does improvement in hyperglycemia occur after bariatric surgery?

1942: Evensen described alimentary hypoglycemic episodes in patients years after surgery for PUD
- Increased insulin sensitivity?

1970s-90s: Reports of rapid improvement in glucose tolerance and T2DM remission after bariatric surgery
- Weight loss not the primary contributor

We still don’t have clear understanding, but it is multifactorial
- Weight loss
- Alterations in gut hormones & bile acids
- Alterations in intestinal nutrient-sensing mechanisms regulating insulin sensitivity
- Vagal afferent and efferent innervation disruption
- Microbiome
- Other factors?

Foregut and Hindgut Hypotheses

Foregut Hypothesis
- Exclusion of segment of proximal intestine (mostly duodenum) from nutrient contact exerts anti-diabetic response
  - Avoids anti-incretins in proximal bowel?

Hindgut Hypothesis
- Bypass leads to expedited transport of nutrients to distal bowel
  - Accentuates GLP-1 & PYY secretion from L-cells
  - +: RYGB and BPD have best glycemic response of bariatric operations
  - -: SG also has glycemic improvement without bypassing proximal bowel
Role of GI Tract in Energy/Glucose Regulation

Nutrients in the GI tract stimulate numerous responses from enteroendocrine cells
- Act on central and peripheral targets
  - Proximal GI Tract
    - I cells, K cells: CCK and GIP
  - Distal GI tract
    - L cells: GLP-1, GLP-2, oxyntomodulin, PYY

Incretin effect
- Oral glucose promotes greater insulin release than parenteral
- Mediated predominantly by GLP-1 and GIP
- T2DM
  - Less incretin effect
  - Reduced GIP action
  - Less circulating GLP-1?

Are there anti-incretins in the proximal gut?

Gut Hormones

Proximal GI Hormones
- Ghrelin
  - Orexigenic, inhibits insulin secretion, suppresses adiponectin
  - Produced by stomach
  - Inverse relationship to body weight
    - Therefore, may contribute to poor results with lifestyle modifications for obesity
  - Improved glucose tolerance in ghrelin-deleted mice
  - Reduced after SG; inconsistent evidence after RYGB
- GIP (glucose-dependent insulino tropic polypeptide)
  - Incretin; increases lipogenesis, inhibits glucagon-stimulated lipolysis
  - K-cells (duodenum, proximal jejunum)
Gut Hormones

Distal GI Hormones

- GLP-1 (glucagon-like peptide-1)
  - Incretin; increases insulin secretion, suppresses glucagon secretion, inhibits gastric emptying, increases beta-cell mass, possibly improves insulin sensitivity
  - L-cells (ileum, colon)
  - Increased levels within days of RYGB or BPD
  - No changes after SG or band

- PYY (peptide-YY)
  - Anorexigenic
  - L-cells
  - Elevated levels after RYGB
  - Animal studies show it may improve insulin resistance

Gut Hormones

Bile Acids

- Believed to be players in regulation of energy balance and metabolism

- Mix with nutrients in duodenum then actively reabsorbed from the TI into portal circulation to return to liver

- BAs activate intestinal FXR which induces synthesis & secretion of FGF-19
  - FGF-19 may improve glucose tolerance

- BAs also stimulate TGR5 receptors on L-cells to stimulate secretion of GLP-1 and PYY

- BAs likely contribute to changes in the microbiome towards lean profile

- 150 patients w/ obesity and T2DM
- Randomly assigned (1:1:1) to
  - Intensive medical therapy alone
  - Medical therapy + sleeve gastrectomy
  - Medical therapy + gastric bypass
- Inclusion criteria
  - BMI 27–43
  - HbA1c > 7.0%
At 1, 3, and 5 years, bypass & sleeve + medical management were superior to medical management alone in:

- T2DM improvement/remission
- Decrease in T2DM and HTN medication requirements
- Weight loss
- Lipid levels
- Quality of life

### ADA Guidelines

8. Obesity Management for the Treatment of Type 2 Diabetes:

**Standards of Medical Care in Diabetes—2019**

*Diabetes Care 2019;42(Suppl. 1):S83–S89 | https://doi.org/10.2337/dc19-S008*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>BMI category (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.0–26.9 (or 23.0–24.9*)</td>
</tr>
<tr>
<td>Diet, physical activity, and behavioral therapy</td>
<td>✓</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>✓</td>
</tr>
<tr>
<td>Metabolic surgery</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Cutoff points for Asian American individuals. *Treatment may be indicated for selected motivated patients.

#### Recommendations

8.11 Metabolic surgery should be considered as an option for adults with type 2 diabetes and BMI 30.0–34.9 kg/m² (27.5–32.4 kg/m² in Asian Americans) who do not achieve durable weight loss and improvement in comorbidities (including hyperglycemia) with reasonable nonsurgical methods. A

8.12 Metabolic surgery may be considered as an option for adults with type 2 diabetes and BMI 30.0–34.9 kg/m² (27.5–32.4 kg/m² in Asian Americans) who do not achieve durable weight loss and improvement in comorbidities (including hyperglycemia) with reasonable nonsurgical methods. A

8.13 Metabolic surgery should be performed in high-volume centers with multidisciplinary teams that understand and are experienced in the management of diabetes and gastrointestinal surgery. C

8.14 Long-term lifestyle support and routine monitoring of microvascular nutritional status should be provided to patients after surgery, according to guidelines for postoperative management of metabolic surgery by national and international professional societies. C

8.15 People presenting for metabolic surgery should receive a comprehensive preoperative and mental health assessment. B

8.16 People who undergo metabolic surgery should be evaluated to assess the need for ongoing mental health services to help them adjust to medical and psychosocial changes after surgery. C
Cardiovascular Risk Factor & Event Reduction

Question: Are the CV risk factor improvements durable over time?

SOS dataset

Incidence and recovery from risk factors

2 and 10 year outcomes
- Follow-up rates: 86.6% & 74.5%, respectively
- 641 surgical, 627 controls at 10 years
Figure 1. Weight Change among Subjects in the SOS Study over a 10-Year Period.

All data are for subjects who completed 10 years of the trial. 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 bars represent the 95% percent confidence intervals.

Figure 2. Incidence of Hypertriglyceridemia, Low HDL Cholesterol, and Hypercholesterolemia among Subjects in the SOS Study over 2 and 10 Years Periods.

Figure 3. Recovery from Diabetes, Lipid Disturbances, Hypertension, and Hypersomnia over 2 and 10 Years in Surgically Treated Subjects and Their Close Controls.
Summary

- 2 and 10 year rates of recovery from CV risks were improved for all except hypercholesterolemia in surgical patients.

- 2 and 10 year incidence of DM, hypertriglyceridemia, and hyperuricemia also improved for surgical group.

- RYGB had better WL and higher degree of improvement in risks versus VBG and bands.
  - But was only 5.3% of surgical patients in this study.

So CV risk factors improve, but what about CV outcomes?
• Retrospective cohort study
• 1998 – 2017; with follow-up through 2018
• All patients with obesity and T2DM that underwent bariatric surgery
  • 2,287
• Matched 1:5 with patients with obesity (BMI 30+) and T2DM
  • 11,435
• Primary endpoint: Major Adverse Cardiovascular Events (MACE)
  • All-cause mortality
  • Coronary events
  • Cerebrovascular events
  • Heart failure
  • Nephropathy
  • Atrial fibrillation
Figure 3. Eight-Year Cumulative Incidence Estimates (Kaplan-Meier) for 6 Individual End Points

A  All-cause mortality

B  Heart failure

C  Coronary artery disease

D  Cerebrovascular disease

<table>
<thead>
<tr>
<th>End Point</th>
<th>Nonsurgical controls</th>
<th>Metabolic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>11,435</td>
<td>2,287</td>
</tr>
<tr>
<td>Heart failure</td>
<td>8,444</td>
<td>1,160</td>
</tr>
<tr>
<td>Coronary artery</td>
<td>7,570</td>
<td>1,017</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>3,005</td>
<td>529</td>
</tr>
<tr>
<td></td>
<td>1,214</td>
<td>353</td>
</tr>
<tr>
<td></td>
<td>19,093</td>
<td>2,649</td>
</tr>
<tr>
<td></td>
<td>7,894</td>
<td>1,231</td>
</tr>
<tr>
<td></td>
<td>4,886</td>
<td>898</td>
</tr>
<tr>
<td></td>
<td>2,468</td>
<td>452</td>
</tr>
<tr>
<td></td>
<td>1,991</td>
<td>317</td>
</tr>
</tbody>
</table>

No. at risk

Nonsurgical controls 11,435 8,444 7,570 3,005 1,214 19,093 7,894 4,886 2,468 1,991
Metabolic surgery 2,287 1,160 1,017 529 353 2,649 1,231 898 452 317

HR, 0.56 (95% CI, 0.46-0.72)
P < .001

HR, 0.38 (95% CI, 0.30-0.49)
P < .001

HR, 0.69 (95% CI, 0.54-0.87)
P < .002

HR, 0.67 (95% CI, 0.48-0.94)
P = .02

Published online September 2, 2019.
**Nephropathy**

<table>
<thead>
<tr>
<th>No. at risk</th>
<th>Nonsurgical controls</th>
<th>Metabolic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>9190</td>
<td>2056</td>
<td>4515</td>
</tr>
<tr>
<td>2252</td>
<td>838</td>
<td>506</td>
</tr>
<tr>
<td>293</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Atrial fibrillation**

<table>
<thead>
<tr>
<th>No. at risk</th>
<th>Nonsurgical controls</th>
<th>Metabolic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>10734</td>
<td>2135</td>
<td>8152</td>
</tr>
<tr>
<td>5212</td>
<td>915</td>
<td>555</td>
</tr>
<tr>
<td>319</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4. Mean Trend Curves of Weight Loss and HbA1c Values Over 8 Years of Follow-up**

- **A** Total weight loss, %
- **B** HbA1c value, %
Figure 5. Proportions of Patients Taking Diabetes and Cardiovascular Drugs Over 8 Years of Follow-up

A. Noninsulin diabetes medications

B. Insulin

C. Renin-angiotensin system inhibitors

D. Other antihypertensive medications

JAMA 1 Original Investigation
Association of Metabolic Surgery With Major Adverse Cardiovascular Outcomes in Patients With Type 2 Diabetes and Obesity
Alz Amer, MD, Alexander Ziebiak, MD, Daniel L. Arellano, MD, MPH, Kathy E. Weisdorf, MPH, Stacey A. Brehm, MD, PhR, R. Schauer, MD, Michael P. Kutler, PhD, Steven L. Nissen, MD
Published online September 2, 2015

51
■ Limitations
  ■ Not able to match based on severity of disease
    ▪ Used E-value to demonstrate robust consistency of results which minimizes effect of unmeasured confounders
  ■ Less than 10% of non-surgical patients received newer anti-DM2 meds (GLP-1 agonists)

■ Conclusions
  ■ Nearly **40% cumulative reduction in risk** of major adverse cardiovascular events
    ▪ Hazard ratio 0.61
  ■ Need RCT to confirm these findings
Obesity & Mortality

8000 surgical: 8000 non-surgical super obese
Mean f/u 7.1 years

RYGB associated with decreased:
- Long-term all-cause mortality by 40%
- CAD-related mortality by 56%
- DM-related mortality by 92%
- Cancer deaths by 60%

RYGB pts had increase in rates of death not caused by disease by 58% (accidents, suicide)
Safety of Surgery

ACS NSQIP database
2007-2012
66,678 patients
16,509 gastric bypass w/ T2DM
Compared rates of adverse events in peri-operative period with other common interventions

- MI
- CVA
- Renal failure
- DVT
- PE
- Pneumonia
- Sepsis
- Septic shock
- Need for transfusion
- Length of stay
- Readmission
- Reoperation
- Mortality
How safe is metabolic/diabetes surgery?

Table 3. Thirty-day postoperative morbidity and mortality rates after laparoscopic Roux-en-Y gastric bypass and other types of surgery in patients with diabetes (N = 66,678).

<table>
<thead>
<tr>
<th>Procedure</th>
<th>LRYGB (n = 16,369)</th>
<th>CABG (n = 2868)</th>
<th>Infrainguinal bypass (n = 10,454)</th>
<th>Laparoscopic partial colectomy (n = 5511)</th>
<th>Laparoscopic cholecystectomy (n = 15,306)</th>
<th>Laparoscopic appendectomy (n = 4537)</th>
<th>Laparoscopic hysterectomy (n = 2309)</th>
<th>Total knee arthroplasty (n = 9184)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complication rate, %</td>
<td>3.4</td>
<td>46.6</td>
<td>23.6</td>
<td>12</td>
<td>3.7</td>
<td>4.5</td>
<td>3.5</td>
<td>16.7</td>
</tr>
<tr>
<td>Mean ± s.d. LOS (days)</td>
<td>2.6 ± 3.0</td>
<td>7.9 ± 6.5</td>
<td>7.0 ± 7.5</td>
<td>6.0 ± 5.6</td>
<td>1.6 ± 3.4</td>
<td>2.5 ± 3.6</td>
<td>1.3 ± 1.9</td>
<td>3.6 ± 2.8</td>
</tr>
<tr>
<td>Readmission, %</td>
<td>6.7</td>
<td>12.4</td>
<td>19.6</td>
<td>9.4</td>
<td>7.8</td>
<td>7.2</td>
<td>4.3</td>
<td>5.2</td>
</tr>
<tr>
<td>Reoperation, %</td>
<td>2.5</td>
<td>6.0</td>
<td>18.9</td>
<td>3.8</td>
<td>1.6</td>
<td>1.8</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>0.3</td>
<td>2.8</td>
<td>2.7</td>
<td>1.8</td>
<td>0.7</td>
<td>0.5</td>
<td>0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

- Gastric bypass group had significantly higher ASA than all except CABG and vascular bypass groups
- Did not include sleeve gastrectomy patients (which is associated with lower risks than gastric bypass)

What happens to my patient after referral to bariatric center?
After referral to bariatric center

- Patients attend an educational class/seminar
  - Bariatric nurse
  - DROP Video
  - Bariatric surgeon
  - Office staff (who have undergone bariatric surgery) Q&A session
- Individual consultation with bariatric surgeon (same appointment as class/seminar)
  - Discuss personal goals
  - Discuss comorbidities
  - Review pros and cons of each procedure unique to that patient
  - Devise pre-operative, operative, and post-operative plan
- Individual consultation with office staff to discuss insurance requirements

After referral to bariatric center

- Patients attend mandatory pre-operative education classes led by bariatric nurses
- Obtain medical clearances
- Pre-operative bariatric appointment 2 weeks before operation
  - Begin 2 week pre-op diet
- Operation
  - Most discharge post-op day 1
- Follow-up appointments
  - 3 weeks
  - 4 months
  - 8 months
  - 12 months
  - Annually thereafter
- Support groups monthly
Effect on the Medicine Cabinet

The procedures
### Adjustable Gastric Band

### Sleeve Gastrectomy

### Roux-en-Y Gastric Bypass

### Duodenal Switch

<table>
<thead>
<tr>
<th></th>
<th>Sleeve Gastrectomy</th>
<th>Gastric Bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Loss</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Diabetes improvement/remission</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>GERD</td>
<td>?</td>
<td>+</td>
</tr>
<tr>
<td>HTN/HLD improvement</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Risks</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>
Individualized Approach to Metabolic Surgery

Postdischarge VTE Risk Assessment For Patients Immediately Following Bariatric Surgery

Venous thromboembolism (VTE) is the most common cause of death after bariatric surgery and most events occur after hospital discharge. The VTE risk assessment tool utilizes ten independent risk factors and identifies high-risk patients who would benefit from post-discharge extended VTE thromboprophylaxis.

Sleeve Gastrectomy Risk Calculator For Patients Immediately Following Laparoscopic Sleeve Gastrectomy

Laparoscopic sleeve gastrectomy is the most common bariatric procedure performed worldwide. Sleeve gastrectomy risk calculator, which specifically estimates 30-day postoperative serious adverse events after laparoscopic sleeve gastrectomy based on seven independent variables, can contribute to surgical decision-making and informed consent for patients.

Weight Formulas For Patients With Obesity

These calculators show expected weight and BMI for different weight loss endpoints after bariatric surgery.

Individualized Metabolic Surgery Score for Procedure Selection For Patients with Type 2 Diabetes

Individualized Metabolic Surgery (IMS) Score categorizes patients with type 2 diabetes into three validated stages for evidence-based bariatric procedure selection (Roux-en-Y gastric bypass (RYGB) vs. sleeve gastrectomy (SG)).

Individualized Diabetes Relapse Risk Score Model 1 For Patients with Type 2 Diabetes before Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy

Surgery Type

RYGB

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)

Preoperative Duration of Diabetes (years)
Individualized Approach to Metabolic Surgery

Individualized Diabetes Relapse Score Models

Individualized Diabetes Complications Risk Scores
For Patients with Type 2 Diabetes
Individualized Diabetes Complications (IDC) risk scores predict the 10-year risk of major adverse cardiovascular events (all-cause mortality, coronary artery events [heart attack, unstable angina, or intervention]), cerebrovascular events (stroke or intervention), heart failure, and diabetic kidney disease with and without undergoing metabolic and bariatric surgery.

Individualized Metabolic Surgery Score for Procedure Selection
For Patients with Type 2 Diabetes
Individualized Metabolic Surgery (IMS) Score categorizes patient with type 2 diabetes into three validated stages for evidence-based bariatric procedure selection (Roux-en-Y gastric bypass [RYGB] vs. sleeve gastrectomy [SG]).
Where are we today?

Challenges

- Less than 1% with severe obesity undergo bariatric surgery each year

Misconceptions

- 78% of people with obesity think they should have the willpower to lose weight
- Most believe diet and exercise is most effective strategy for long-term weight loss
  - Believe diet & exercise more effective than prescription weight loss medications and bariatric surgery
- 82% of people with obesity feel “completely responsible” for poor weight loss
Challenges

- **Stigma**
  - Survey in JAMA Surgery
    - 49.4% believe bariatric surgery is cosmetic
    - 40% believe bariatric surgery is “the easy way out”
  - Obesity is a difficult subject to approach
    - Only 1 in 3 with obesity report ever speaking with a provider about weight
    - Only 12% report a physician recommending consideration of bariatric surgery

- **Insurance coverage**

Growing Interest and Support

- **Physicians**
  - Record number applied to take American Board of Obesity Medicine certification exam in 2019 (890)
  - Need to collaborate between specialties. We are treating the same disease process, but rather than attacking the source, we are individually attacking the sequelae.
  - Bariatric surgery should no longer be seen as a treatment of last resort
    - The earlier the treatment, the better the outcomes
    - We wouldn’t wait until end stage renal disease or heart failure before beginning treatment
ADA Guidelines

8. Obesity Management for the Treatment of Type 2 Diabetes: Standards of Medical Care in Diabetes—2019

Table 8.1—Treatment options for overweight and obesity in type 2 diabetes

<table>
<thead>
<tr>
<th>Treatment</th>
<th>BMI category (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.0–26.9 (or 29.0–29.9)</td>
</tr>
<tr>
<td>Diet, physical activity, and behavioral therapy</td>
<td>?</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>?</td>
</tr>
<tr>
<td>Metabolic surgery</td>
<td>?</td>
</tr>
</tbody>
</table>

*Cut-off points for Asian American individuals. *Treatment may be indicated for selected motivated patients.

8.11 Metabolic surgery should be recommended as an option to treat type 2 diabetes in appropriate surgical candidates with BMI ≥40 kg/m² (BMI ≥37.5 kg/m² in Asian Americans) and in adults with BMI 35.0–39.9 kg/m² (32.5–37.4 kg/m² in Asian Americans) who do not achieve durable weight loss and improvement in comorbidities (including hyperglycemia) with reasonable nonsurgical methods. A

8.12 Metabolic surgery may be considered as an option for adults with type 2 diabetes and BMI 30.0–34.9 kg/m² (27.5–32.4 kg/m² in Asian Americans) who do not achieve durable weight loss and improvement in comorbidities (including hyperglycemia) with reasonable nonsurgical methods. A

8.13 Metabolic surgery should be performed in high-volume centers with multidisciplinary teams that understand and are experienced in the management of diabetes and gastrointestinal surgery. C

8.14 Long-term lifestyle support and routine monitoring of micronutrient and nutritional status must be provided to patients after surgery, according to guidelines for postoperative management of bariatric surgery by national and international professional societies. C

8.15 People presenting for metabolic surgery should receive a comprehensive readiness and mental health assessment. B

8.16 People who undergo metabolic surgery should be evaluated to assess the need for ongoing mental health services to help them adjust to medical and psychosocial changes after surgery. C

---

**Policy Statement**

Pediatric Metabolic and Bariatric Surgery: Evidence, Barriers, and Best Practices

- Pediatric obesity is an “epidemic within an epidemic”
  - 4.5 million children in the U.S. have severe obesity (BMI ≥ 35);
  - 14% of 16-19 year-olds

- High risk for developing chronic and progressive diseases
  - Hypertension
  - Dyslipidemia
  - Obstructive sleep apnea
  - Polycystic ovarian syndrome
  - Type 2 diabetes mellitus
  - Fatty liver disease
  - Bone and joint dysfunction
  - Depression
  - Social isolation
  - Poor quality of life
• At 3 years, teens who underwent bypass or sleeve:
  ▪ Mean weight reduction: 27%
  ▪ Resolution of T2DM: 95%
  ▪ Resolution of HTN: 74%
  ▪ Resolution of dyslipidemia: 66%

• “Surgical treatment is more effective than medical therapy among adolescents with severe obesity for treatment of type 2 diabetes mellitus”

• “Weight-related quality of life has also been shown to improve significantly”

Practice-Level Recommendations

The AAP recommends that pediatricians do the following.

1. Recognize that severe obesity (BMI ≥ 35 or ≥ 120% of the 95th percentile for age and sex) places the adolescent at higher risk for liver disease, type 2 diabetes mellitus, dyslipidemias, sleep apnea, orthopedic complications, and mental health conditions even when compared with milder degrees of obesity.

2. Seek high-quality multidisciplinary centers that are experienced in assessing risks and benefits of various treatments for youth with severe obesity, including bariatric surgery, and provide referrals to where such programs are available.

3. Understand the efficacy, risks, benefits, and long-term health implications of the common metabolic and bariatric surgery procedures so that pediatricians can effectively help in family medical decision-making concerning surgical options to manage severe obesity.

4. Identify pediatric patients with severe obesity who meet criteria for surgery (Table 1) and provide timely referrals to comprehensive, multidisciplinary, pediatric-focused metabolic and bariatric surgery programs.

5. Coordinate pre- and postoperative care with the patient, family, and multidisciplinary, anesthesia, and surgical teams.

6. Monitor patients postoperatively for micronutrient deficiencies and consider providing iron, folate, and vitamin B12 supplementation as needed.

7. Monitor patients postoperatively for risk-taking behavior and mental health problems.
Pediatric Metabolic and Bariatric Surgery: Evidence, Barriers, and Best Practices

Sarah C. Armstrong, MD, FAAP, Christopher T. Italy, MD, FAAP, David R. Jackson, MD, FAAP, Jason E. Berk, MD

System-Level Recommendations

The AAP recommends that pediatricians do the following.

1. Advocate for increased access for pediatric patients of all racial, ethnic, and socioeconomic backgrounds to multidisciplinary programs that provide high-quality pediatric metabolic and bariatric surgery.

The AAP recommends that government, health, and academic medical centers do the following.

1. Use best practice guidelines outlined in this policy statement to support safe and effective multidisciplinary, pediatric-focused metabolic and bariatric surgery programs. This guidance is considered best practice because it is based on consensus expert opinion after reviewing numerous practices in various settings.

2. Consider best practice guidelines, including avoidance of unsubstantiated lower age limits, in the context of potential health care benefits and individualized patient-centered care.

3. Increase the number of and access to multidisciplinary, pediatric-focused metabolic and bariatric surgery centers, ensuring equal access to adolescents who meet criteria regardless of income, race, or ethnicity.

The AAP recommends that public and private insurers do the following.

1. Provide payment for multidisciplinary preoperative care to ensure appropriate selection of surgical candidates and for multidisciplinary postoperative care and required medications and supplements to improve surgical outcomes.

2. Provide payment for bariatric surgery from evaluation through follow-up and ongoing care for pediatric patients who meet standard criteria as set forth here.

3. Reduce barriers to pediatric metabolic and bariatric surgery (including inadequate payment, limited access, unsubstantiated exclusion criteria, and bureaucratic delays in approval requiring unnecessary and often numerous appeals) for patients who meet careful selection criteria.

81
Audience Q

1. How likely are you to discuss your patient’s weight and obesity with them?

2. What hinders you from initiating this conversation?

3. Any suggestions, tips, tricks to help facilitate the conversation?
Final Thoughts

• Let’s treat the *disease* of obesity rather than wait to treat the harmful sequelae
  • Root cause analysis

• If uncomfortable offering dietary, exercise, and medical therapeutic advice, use resources!
  • Obesity Medicine specialists, Weight reduction programs

• Once the sequelae develop, the sooner we treat with bariatric procedure, the better the outcomes!

• Refer to bariatric surgeons/centers that take individual approach to patient care
  • Patients are different – they will benefit from different procedures

• See T2DM, think bariatric surgery!!

“Imagine if 99% of patients with diabetes, cancer, or heart disease did not seek or receive medical treatment because the barriers were too high. The outcry would be unimaginable. But somehow it is more acceptable to treat the devastating consequences of obesity rather than the disease itself.”

*John Morton MD, MPH, MHA*

*Joseph Nadglowski*
Thank you

Charles Keith MD
Assistant Professor of Surgery
Bariatric and General Surgery
University of Texas Health Science Center at Tyler