Impact of Morbid Obesity on Injury Severity Score and Outcomes

Luiz Foerntes, MD
Nicole Woll, PhD
Joseph Blansfield, MD
Susan Baro, DO
Denise Torres, MD
Jeffrey Wild, MD
Dianne Leonard, MD
Kenneth Widom, MD

Trauma Surgery
Geisinger Medical Center
Obesity in the United States

- Increased risk for type 2 diabetes, hypertension and hyperlipidemia

- 36% of adult Americans are obese (2010)

- 17% of children and adolescents are affected

- 8% increase in obesity rates among males between 1999 and 2010

CDC, January 2012
Trauma in the United States

- 5th leading cause of death among all ages in 2010, with 120,859 deaths
- 1st leading cause of deaths between 1 and 44 years of age
- 3rd cause of death between 45 and 54 years of age

CDC, October 2012
Obesity and Trauma

- Conflicting data correlating high Body Mass Index (BMI) and mortality\(^1\)

- Increased chest and extremity trauma and decreased head injury in obese patients\(^1\)

- Increased incidence of multiple organ failure and wound infection in obese trauma patients\(^2\)

Research Questions

Does increasing BMI correlate with decreasing Injury Severity Score (ISS)?

Do lower ISS scores in high BMI patients impact clinical outcomes?
Methods

• Retrospective Cohort Study
• GMC Trauma Registry
• All trauma patients older than 18 years of age admitted to GMC Trauma Service between January 1, 2007 and December 31, 2011

• Variables:
  – BMI, age, gender, pre-existing conditions, injury type, ISS, length of stay (LOS), ICU days, total ventilation days, surgeries, complications and mortality
Pre-existing Conditions and Complications

• Pre-existing conditions:
Cardiac, diabetes, gastrointestinal, hematologic, psychiatric, immunosuppression, liver, malignancy, musculoskeletal, neurologic, obesity, pulmonary, renal, substance abuse, pregnancy, previous trauma, endocrine, congenital

• Complications:
Airway management, burn, cardiovascular, decubitus, gastrointestinal, hematologic/coagulopathy, hypothermia, infection/sepsis, neurologic, pharmacologic, procedure related, pulmonary, renal
BMI stratification

- Thin below 19 kg/m²
- Normal 20- 24 kg/m²
- Pre-obese 25- 29 kg/m²
- Obese Class I 30- 34 kg/m²
- Obese Class II 35- 40 kg/m²
- Obese Class III was further stratified on:
  - BMI 40- 49 kg/m²
  - BMI 50- 59 kg/m²
  - BMI 60 kg/m² and above
Population

7596 trauma patients

4333 patients included

3263 patients excluded
(Unable to calculate BMI or ISS)

133 Thin
1409 Normal
1408 Pre-obese
766 Class I
330 Class II
230 BMI 40-49
41 BMI 50-59
16 BMI 60 +
BMI and ISS

ISS

BMI

- Thin
- Normal
- Pre-obese
- Class I
- Class II
- BMI 40-49
- BMI 50-59
- BMI 60+
# BMI and Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Thin</th>
<th>Normal</th>
<th>Pre-obese</th>
<th>Class I</th>
<th>Class II</th>
<th>BMI 40-49</th>
<th>BMI 50-59</th>
<th>BMI 60+</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># of patients</strong></td>
<td>133</td>
<td>1409</td>
<td>1408</td>
<td>766</td>
<td>330</td>
<td>230</td>
<td>41</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Gender (female)</strong></td>
<td>85</td>
<td>590</td>
<td>461</td>
<td>273</td>
<td>132</td>
<td>113</td>
<td>21</td>
<td>10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(% )</td>
<td>(63.9)</td>
<td>(41.9)</td>
<td>(32.7)</td>
<td>(35.6)</td>
<td>(40)</td>
<td>(49.1)</td>
<td>(51.2)</td>
<td>(62.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Pre-existing conditions</strong></td>
<td>108</td>
<td>965</td>
<td>985</td>
<td>588</td>
<td>289</td>
<td>217</td>
<td>39</td>
<td>16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(% )</td>
<td>(81.2)</td>
<td>(68.5)</td>
<td>(70)</td>
<td>(76.8)</td>
<td>(87.62)</td>
<td>(94.4)</td>
<td>(95.1)</td>
<td>(100)</td>
<td></td>
</tr>
<tr>
<td><strong>ISS &gt; 15</strong></td>
<td>55</td>
<td>587</td>
<td>580</td>
<td>328</td>
<td>125</td>
<td>76</td>
<td>8</td>
<td>3</td>
<td>0.003</td>
</tr>
<tr>
<td>(% )</td>
<td>(41.4)</td>
<td>(41.8)</td>
<td>(41.3)</td>
<td>(42.9)</td>
<td>(38.1)</td>
<td>(33)</td>
<td>(19.5)</td>
<td>(18.8)</td>
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</tr>
<tr>
<td><strong>LOS</strong></td>
<td>6.2</td>
<td>5.9</td>
<td>6.4</td>
<td>7.2</td>
<td>6.9</td>
<td>8.4</td>
<td>8.4</td>
<td>11.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Surgery</strong></td>
<td>55</td>
<td>598</td>
<td>660</td>
<td>378</td>
<td>162</td>
<td>136</td>
<td>24</td>
<td>11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(% )</td>
<td>(41.4)</td>
<td>(42.4)</td>
<td>(47.3)</td>
<td>(49.4)</td>
<td>(49.1)</td>
<td>(59.1)</td>
<td>(58.5)</td>
<td>(68.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td>20</td>
<td>141</td>
<td>165</td>
<td>117</td>
<td>44</td>
<td>41</td>
<td>6</td>
<td>4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>(% )</td>
<td>(15)</td>
<td>(10)</td>
<td>(11.7)</td>
<td>(15.30)</td>
<td>(13.3)</td>
<td>(17.8)</td>
<td>(14.6)</td>
<td>(25)</td>
<td></td>
</tr>
</tbody>
</table>
## BMI and Outcomes

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<td>1408</td>
<td>766</td>
<td>330</td>
<td>230</td>
<td>41</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>60.9</td>
<td>54.9</td>
<td>55.9</td>
<td>54.7</td>
<td>53.1</td>
<td>54.5</td>
<td>56</td>
<td>57.8</td>
<td>0.29</td>
</tr>
<tr>
<td><strong>Type of injury (blunt)</strong> (%)</td>
<td>132 (99.3)</td>
<td>1356 (96.2)</td>
<td>1358 (96.5)</td>
<td>738 (96.3)</td>
<td>316 (95.8)</td>
<td>226 (98.3)</td>
<td>41 (100)</td>
<td>16 (100)</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>ICU days</strong></td>
<td>1.6</td>
<td>1.3</td>
<td>1.6</td>
<td>1.7</td>
<td>1.9</td>
<td>2.7</td>
<td>2.6</td>
<td>2.9</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Ventilation days</strong></td>
<td>0.8</td>
<td>0.7</td>
<td>1.0</td>
<td>1.0</td>
<td>1.2</td>
<td>3.0</td>
<td>1.5</td>
<td>1.6</td>
<td>0.23</td>
</tr>
<tr>
<td><strong>Death (%)</strong></td>
<td>11 (8.3)</td>
<td>59 (4.2)</td>
<td>74 (5.3)</td>
<td>34 (4.4)</td>
<td>13 (3.9)</td>
<td>15 (6.5)</td>
<td>0</td>
<td>1 (6.3)</td>
<td>0.73</td>
</tr>
</tbody>
</table>
## BMI and Outcomes

<table>
<thead>
<tr>
<th>Effect</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-obese vs. Thin and Normal</td>
<td>0.96</td>
<td>0.83- 1.11</td>
</tr>
<tr>
<td>Class I vs. Thin and Normal</td>
<td>1.01</td>
<td>0.85- 1.21</td>
</tr>
<tr>
<td>Class II vs. Thin and Normal</td>
<td>0.82</td>
<td>0.64- 1.05</td>
</tr>
<tr>
<td>Class III vs. Thin and Normal</td>
<td>0.58</td>
<td>0.44- 0.77</td>
</tr>
</tbody>
</table>
### BMI and Injury per Body Region

<table>
<thead>
<tr>
<th>Body Region</th>
<th>BMI</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and Neck</td>
<td>Class III</td>
<td>0.56</td>
<td>0.36 - 0.87</td>
</tr>
<tr>
<td>Chest</td>
<td>Class III</td>
<td>1.86</td>
<td>1.09 - 3.16</td>
</tr>
</tbody>
</table>
Results

• Increased BMI was associated with decreased ISS scores

• All patients with BMI above 60 kg/m² had pre-existing conditions

• Even with lower ISS, high BMI patients had increased LOS, surgeries and complications

• Although not statistically significant, a trend was seen for increased ICU and ventilation days
Results

- Class III obese patients had 41% lower odds of severe injuries compared to thin or normal BMI patients.

- Class III obese patients have 44% lower chance to have severe injuries in the head or neck region if compared to the normal BMI patients.

- Class III patients have 86% more chance to have severe injuries in the chest if compared to the normal BMI patients.
Conclusion

• As the prevalence of morbid obesity continues to increase in the United States, more obese patients will be encountered in the trauma setting.

• We propose that morbidly obese patients require a higher level of care since even with low ISS scores this population tends to have an increased morbidity compared with normal BMI patients.
Questions?