Visceral Obesity, Not Elevated BMI, Is Strongly Associated with Incisional Hernia after Colorectal Surgery

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Financial Disclosures

No financial disclosures
Background

- 360,000 ventral hernia repairs annually in the U.S.
- $3.2 billion per year spent on repairs\(^1\)
- Hernia recurrence rate = 24% to 43%

Major Risk Factors

- Fascial closure technique
- Surgical site infection (SSI)
- Obesity
  - Increased body mass index (BMI)
Body Mass Index (BMI)

- Proxy for adiposity
- Hernia risk-stratification
  - Prophylactic mesh placement
- Does not accurately reflect abdominal fat distribution

Linear Regression of Measurements

<table>
<thead>
<tr>
<th></th>
<th>BMI</th>
<th>VFV</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>1.000</td>
<td>0.304</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.651</td>
<td>0.587</td>
</tr>
<tr>
<td>Visceral Fat Volume (VFV)</td>
<td>0.304</td>
<td>1.000</td>
</tr>
<tr>
<td>Subcutaneous Fat Volume</td>
<td>0.609</td>
<td>0.183</td>
</tr>
<tr>
<td>Total Fat Volume</td>
<td>0.651</td>
<td>0.609</td>
</tr>
</tbody>
</table>

Values = $R^2$

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3Rickles AS et al. Visceral obesity and colorectal cancer: are we missing the boat with BMI? *J Gastrointest Surg* 2013; 17(1): 133-143.
Visceral Obesity?

- Associated with:
  - ↑ intra-abdominal pressure\textsuperscript{4}
  - ↑ risk of SSI\textsuperscript{5}

Aims

Examine the relationship between abdominal fat measurements and risk of incisional hernia

- BMI vs. visceral fat volume
- More accurate risk-stratification
Study Cohort

496 patients underwent colorectal cancer resection with pre-operative imaging

**Exclusion**
1) Stage 0 or stage 4 cancer (n=131)
2) Emergent cases (n=42)
3) IBD or HNPCC (n=25)
4) Inadequate imaging (n=79)
5) No abdominal incision (n=3)
6) Mesh repair at surgery (n=2)
7) Death or loss of f/u within 6 months (n=21)

**Final Cohort**
193 patients
Methods

- Visceral fat volume (VFV) measured from preoperative CT scans
  - Selected by Hounsfield units (-50 to -190)\(^1\)

- Fat volume from S1 to 12 cm cranial

\(^1\)Rickles AS et al. Visceral obesity and colorectal cancer: are we missing the boat with BMI? *J Gastrointest Surg* 2013; 17(1): 133-143.
Definition of Obesity

- No standardized cut-off values for visceral obesity
- Receiver operating characteristic (ROC) curves constructed

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Cut-Off Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index (BMI)</td>
<td>≥ 30 kg/m²</td>
</tr>
<tr>
<td>Visceral Fat Volume (VFV)</td>
<td>Males: ≥ 2250 cm³</td>
</tr>
<tr>
<td></td>
<td>Females: ≥ 1560 cm³</td>
</tr>
</tbody>
</table>
Statistical Methods

**Bivariate Analysis**
Chi-Square Test
Kaplan-Meier
Student’s T-Test
Mann Whitney-U Test

**Time to Incisional Hernia**
Cox Proportional Hazards Model
## Patient Characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Viscerally Non-Obese n=127 (65.8%)</th>
<th>Viscerally Obese n=66 (34.2%)</th>
<th>( P )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>65</td>
<td>70</td>
<td>0.003*</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>99 (78%)</td>
<td>60 (90.9%)</td>
<td>0.03*</td>
</tr>
<tr>
<td>African-American</td>
<td>20 (15.7%)</td>
<td>6 (9.1%)</td>
<td>0.2</td>
</tr>
<tr>
<td>Other</td>
<td>8 (6.3%)</td>
<td>0 (0%)</td>
<td>0.04*</td>
</tr>
<tr>
<td>Arterial aneurysm</td>
<td>15 (11.8%)</td>
<td>15 (22.7%)</td>
<td>0.05*</td>
</tr>
<tr>
<td>Specimen Extraction Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>75 (59.1%)</td>
<td>37 (56.1%)</td>
<td>0.21</td>
</tr>
<tr>
<td>Laparoscopic Midline</td>
<td>22 (17.3%)</td>
<td>18 (27.3%)</td>
<td></td>
</tr>
<tr>
<td>Laparoscopic Transverse</td>
<td>30 (23.6%)</td>
<td>11 (16.7%)</td>
<td></td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>10 (7.9%)</td>
<td>17 (25.8%)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Incisional hernia</td>
<td>20 (15.7%)</td>
<td>21 (31.8%)</td>
<td>0.01*</td>
</tr>
</tbody>
</table>
Cox Proportional-Hazards Model

HR = 2.04 (1.07, 3.91)
Visceral Obesity

BMI ≥ 30

Inguinal Hernia

Laparoscopic Transverse Incision

Also controlled for age, race, diabetes mellitus, COPD, history of arterial aneurysm, perioperative corticosteroid use
Limitations

- Retrospective design
- Small sample size
- No standardized cut-off values for VO
Strengths

- First to investigate VO and incisional hernia
- Validated method for fat measurement
- Long median length of follow-up (4.7 years)
Summary

- **Risk Factors for Incisional hernia**
  - High visceral fat volume (*not BMI*)
  - History of inguinal hernia

- **Protective Factors against Incisional Hernia**
  - Specimen extraction through transverse incision
Pathogenesis?

**↑Intra-Abdominal Pressure**

**Visceral Obesity** ➔ **SSI** ➔ **Incisional Hernia**

Other factors?
Conclusions/Future Directions

- Off-midline incision is extraction site of choice
- Viscerally obese patients may benefit from prophylactic mesh placement