Long-term effects of bariatric surgery on acute kidney injury: A propensity-matched cohort in the United Kingdom Clinical Practice Research Datalink

Supporting Information

Overview

S1 Appendix – Code List for Identification of patients with bariatric surgery
S2 Appendix – Association of potential confounders with bariatric surgery and AKI
S3 Appendix – Patient selection from the original cohort
S4 Appendix – Sensitivity Analyses
Appendix 1: Code List for identification of patients with bariatric surgery from the CPRD database as published by Douglas et al. [7]

<table>
<thead>
<tr>
<th>Read code</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>76132.00</td>
<td>Laparoscopic adjustable gastric banding</td>
</tr>
<tr>
<td>76134.00</td>
<td>Partitioning of stomach using staples</td>
</tr>
<tr>
<td>76131.11</td>
<td>Mason vertical banded gastroplasty</td>
</tr>
<tr>
<td>76133.00</td>
<td>Partitioning of stomach using band</td>
</tr>
<tr>
<td>76116.00</td>
<td>Laparoscopic sleeve gastrectomy</td>
</tr>
<tr>
<td>76115.00</td>
<td>Sleeve gastrectomy NEC</td>
</tr>
<tr>
<td>76425.00</td>
<td>Duodenal switch</td>
</tr>
<tr>
<td>76135.00</td>
<td>Partitioning of stomach NEC</td>
</tr>
<tr>
<td>76114.00</td>
<td>Sleeve gastrectomy and duodenal switch</td>
</tr>
<tr>
<td>76166.00</td>
<td>Laparoscopic gastric bypass</td>
</tr>
</tbody>
</table>
Appendix 2: Identification of potential confounders in the association of bariatric surgery (exposure) and the endpoint of incident AKI (outcome) in patients of the linked CPRD/HES cohort

<table>
<thead>
<tr>
<th>RR (95%CI)</th>
<th>Change in %</th>
<th>Selection for multivariable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude effect estimate</td>
<td>0.62 (0.40, 0.95)</td>
<td></td>
</tr>
<tr>
<td>Effect estimates when individually adjusting for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.62 (0.40, 0.95)</td>
<td>0.2 % yes (a priori)</td>
</tr>
<tr>
<td>Sex</td>
<td>0.60 (0.39, 0.92)</td>
<td>2.7 % yes (a priori)</td>
</tr>
<tr>
<td>Calendar Time</td>
<td>0.61 (0.40, 0.94)</td>
<td>0.9 % yes (a priori)</td>
</tr>
<tr>
<td>CKD status at baseline</td>
<td>0.59 (0.38, 0.91)</td>
<td>4.4 % yes (a priori)</td>
</tr>
<tr>
<td>BMI at baseline</td>
<td>0.53 (0.34, 0.83)</td>
<td>13.9 % yes</td>
</tr>
<tr>
<td>Alcohol Status</td>
<td>0.61 (0.40, 0.93)</td>
<td>1.3 % no</td>
</tr>
<tr>
<td>Smoking Status</td>
<td>0.61 (0.40, 0.94)</td>
<td>0.3 % no</td>
</tr>
<tr>
<td>History of cerebrovascular disease</td>
<td>0.61 (0.40, 0.94)</td>
<td>0.6 % no</td>
</tr>
<tr>
<td>History of coronary heart disease</td>
<td>0.60 (0.39, 0.91)</td>
<td>3.3 % no</td>
</tr>
<tr>
<td>History of peripheral vascular disease</td>
<td>0.64 (0.41, 0.98)</td>
<td>3.2 % no</td>
</tr>
<tr>
<td>History of other atheroma</td>
<td>0.62 (0.40, 0.95)</td>
<td>0.0 % no</td>
</tr>
<tr>
<td>History of diabetes</td>
<td>0.60 (0.39, 0.92)</td>
<td>2.7 % no</td>
</tr>
<tr>
<td>History of taking oral antidiabetics</td>
<td>0.55 (0.36, 0.85)</td>
<td>10.4 % yes</td>
</tr>
<tr>
<td>History of taking insulin</td>
<td>0.57 (0.37, 0.87)</td>
<td>7.9 % no</td>
</tr>
<tr>
<td>History of hypertension</td>
<td>0.61 (0.40, 0.94)</td>
<td>1.1 % no</td>
</tr>
<tr>
<td>History of statin use</td>
<td>0.58 (0.38, 0.89)</td>
<td>5.5 % no</td>
</tr>
<tr>
<td>History of AKI</td>
<td>0.42 (0.26, 0.67)</td>
<td>31.9 % yes</td>
</tr>
</tbody>
</table>

Variables were added individually to the univariable model testing the association between bariatric surgery and AKI. If the addition of the respective variable changed the model ≥10% then the variable was selected to be included in the multivariable model.

AKI = acute kidney injury, BMI = body mass index, CKD = chronic kidney disease
Appendix 3: Patient selection from the original cohort as described in Douglas et al [7]

Propensity score-matched cohort from Douglas et al:

3 882 patients with bariatric surgery
3 882 patients without bariatric surgery

Exclude patients from GP practices without linkage to HES database

Exclusion of:
1 239 patients with bariatric surgery
1 287 patients without bariatric surgery

Cohort for analysis of acute kidney injury:

2 643 patients with bariatric surgery
2 595 patients without bariatric surgery
Appendix 4: Sensitivity analyses for the association of bariatric surgery with acute kidney injury

<table>
<thead>
<tr>
<th></th>
<th>PY Events</th>
<th>Rate per 1000 PY (95% CI)</th>
<th>Crude RR (95% CI)</th>
<th>p-value</th>
<th>Adjusted RR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Restricted to patients without CKD at baseline (available serum creatinine measures + eGFR ≥60)</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Day 1-30</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexposed</td>
<td>98</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bariatric surgery</td>
<td>111</td>
<td>&lt;5*</td>
<td>36.2 (13.6, 96.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Day 30</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unexposed</td>
<td>3,550</td>
<td>27</td>
<td>7.6 (5.2, 11.1)</td>
<td></td>
<td></td>
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<tr>
<td>Bariatric surgery</td>
<td>4,311</td>
<td>22</td>
<td>5.1 (3.4, 7.7)</td>
<td>0.67 (0.38, 1.18)</td>
<td>0.165</td>
<td>0.53 (0.29, 1.00)</td>
</tr>
<tr>
<td><strong>Restricted to patients without known CKD at baseline (available serum creatinine measures + eGFR ≥60 or missing eGFR at baseline)</strong></td>
<td></td>
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<tr>
<td><strong>Day 1-30</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unexposed</td>
<td>199</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bariatric surgery</td>
<td>195</td>
<td>&lt;5*</td>
<td>20.5 (7.7, 54.7)</td>
<td></td>
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<tr>
<td><strong>Day 30</strong></td>
<td></td>
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<tr>
<td>Unexposed</td>
<td>7,735</td>
<td>42</td>
<td>5.4 (4.0, 7.3)</td>
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<tr>
<td>Bariatric surgery</td>
<td>7,930</td>
<td>27</td>
<td>3.4 (2.3, 5.0)</td>
<td>0.63 (0.39, 1.02)</td>
<td>0.058</td>
<td>0.42 (0.25, 0.73)</td>
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<tr>
<td><strong>Excluding patients with CKD stage 4</strong></td>
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<tr>
<td><strong>Day 1-30</strong></td>
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<td></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>203</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Bariatric surgery</td>
<td>198</td>
<td>&lt;5*</td>
<td>25.2 (10.5, 60.6)</td>
<td></td>
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<tr>
<td><strong>Day 30</strong></td>
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<tr>
<td>Unexposed</td>
<td>7,875</td>
<td>52</td>
<td>6.6 (5.0, 8.7)</td>
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<tr>
<td>Bariatric surgery</td>
<td>8,037</td>
<td>32</td>
<td>4.0 (2.8, 5.6)</td>
<td>0.60 (0.39, 0.94)</td>
<td>0.024</td>
<td>0.35 (0.21, 0.59)</td>
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<tr>
<td><strong>Restricted to patients with T2DM</strong></td>
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<tr>
<td>Unexposed</td>
<td>65</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Bariatric surgery</td>
<td>69</td>
<td>&lt;5*</td>
<td>43.6 (14.1, 135.1)</td>
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<tr>
<td><strong>Day 30</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>2,325</td>
<td>33</td>
<td>14.2 (10.1, 20.0)</td>
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<tr>
<td>Bariatric surgery</td>
<td>2,548</td>
<td>18</td>
<td>7.1 (4.5, 11.2)</td>
<td>0.50 (0.28, 0.88)</td>
<td>0.017</td>
<td>0.25 (0.13, 0.51)</td>
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<td><strong>Restricted to patients with a history of taking insulin</strong></td>
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<tr>
<td><strong>Day 1-30</strong></td>
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<tr>
<td>Unexposed</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>-</td>
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<tr>
<td>Bariatric surgery</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Day 30</strong></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>321</td>
<td>11</td>
<td>34.3 (19.0, 61.9)</td>
<td></td>
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<tr>
<td>Bariatric surgery</td>
<td>502</td>
<td>9</td>
<td>17.9 (9.3, 34.5)</td>
<td>0.52 (0.22, 1.26)</td>
<td>0.150</td>
<td>0.22 (0.08, 0.64)</td>
</tr>
<tr>
<td><strong>Restricted to ICD-10 codes N17.0 and N17.9</strong></td>
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<tr>
<td><strong>Day 1-30</strong></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>202</td>
<td>0</td>
<td>0</td>
<td>-</td>
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<td></td>
</tr>
<tr>
<td>Bariatric surgery</td>
<td>199</td>
<td>&lt;5*</td>
<td>25.2 (10.5, 60.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Day 30</strong></td>
<td></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>7,871</td>
<td>48</td>
<td>6.1 (4.6, 8.1)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Bariatric surgery</td>
<td>8,055</td>
<td>31</td>
<td>3.8 (2.7, 5.5)</td>
<td>0.63 (0.40, 0.99)</td>
<td>0.046</td>
<td>0.40 (0.24, 0.67)</td>
</tr>
<tr>
<td><strong>Having an initial post-surgery time span of 60 days instead of 30</strong></td>
<td></td>
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<td><strong>Day 1-60</strong></td>
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</tr>
<tr>
<td>Unexposed</td>
<td>403</td>
<td>&lt;5*</td>
<td>2.5 (0.3, 17.6)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bariatric surgery</td>
<td>395</td>
<td>6</td>
<td>15.2 (6.8, 33.8)</td>
<td>6.11 (0.74, 50.8)</td>
<td>0.094</td>
<td>4</td>
</tr>
<tr>
<td><strong>Day 60</strong></td>
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<tr>
<td>Unexposed</td>
<td>7,682</td>
<td>53</td>
<td>6.9 (5.3, 9.0)</td>
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<tr>
<td>Bariatric surgery</td>
<td>7,864</td>
<td>33</td>
<td>4.2 (3.0, 5.9)</td>
<td>0.61 (0.39, 0.94)</td>
<td>0.025</td>
<td>0.38 (0.23, 0.63)</td>
</tr>
</tbody>
</table>

Test for interaction $^5$ 0.011
Including patients with extreme propensity scores

<table>
<thead>
<tr>
<th>Day 1-30</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unexposed</td>
<td>208</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bariatric surgery</td>
<td>206</td>
<td>5</td>
<td>24.3</td>
</tr>
<tr>
<td>&gt; Day 30</td>
<td>Unexposed</td>
<td>8,054</td>
<td>59</td>
<td>7.3 (5.7, 9.5)</td>
</tr>
<tr>
<td></td>
<td>Bariatric surgery</td>
<td>8,324</td>
<td>34</td>
<td>4.1 (2.9, 5.7)</td>
</tr>
</tbody>
</table>

Excluding patients with BMI < 35 kg/m² at baseline

<table>
<thead>
<tr>
<th>Day 1-30</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unexposed</td>
<td>180</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bariatric surgery</td>
<td>175</td>
<td>&lt;5</td>
<td>22.8 (8.6, 60.9)</td>
</tr>
<tr>
<td>&gt; Day 30</td>
<td>Unexposed</td>
<td>6,714</td>
<td>48</td>
<td>7.1 (5.4, 9.5)</td>
</tr>
<tr>
<td></td>
<td>Bariatric surgery</td>
<td>7,100</td>
<td>32</td>
<td>4.5 (3.2, 6.4)</td>
</tr>
</tbody>
</table>

1 Poisson regression model
2 Wald test for RR, Likelihood-Ratio Test for interaction
3 Poisson regression model adjusted for age at baseline, sex, calendar time, CKD at baseline, history of AKI, history of taking oral antidiabetics, and BMI at baseline
4 No analysis for day 1-30 owing to sparse data
5 Test for interaction of the effect estimate with the time periods 1-30 days and >30 days
6 Cell counts <5 have been suppressed to ensure anonymity

AKI = acute kidney injury, CKD = chronic kidney disease, PY = person-years, RR = rate ratio