Concurrent bariatric operations and association with perioperative outcomes

Liu JB, Ban KA, Berian JR, et al

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Study question Are patients who have concurrent bariatric operations (surgeon performs critical parts of operations on two patients simultaneously) at greater risk of perioperative complications compared with those who do not?

Methods This study used registry data from the American College of Surgeons’ metabolic and bariatric surgery accreditation and quality improvement programme. Operations were defined as concurrent if they overlapped by ≥60 minutes or in their entirety. Of the 513,167 operations included, 6087 (1.2%) were concurrent using this definition. Patients who underwent concurrent metabolic and bariatric operations were then propensity score matched 1:1 to those who did not. A composite measure of 30 day death, morbidity, readmission, reoperation, anastomotic or staple line leak, and bleeding events was then compared between the groups.

Study answer and limitations Perioperative complications were not observed to more likely occur in concurrent compared with non-concurrent operations (7.5% vs 7.4%; relative risk 1.02, 95% confidence interval 0.90 to 1.15; P=0.84). The effect of operating concurrently on perioperative complications in other types of surgery could not be assessed with these data.

What this study adds In these data, no differences in 30 day outcomes were detected in patients who underwent concurrent versus non-concurrent bariatric surgery at US centres accredited by the metabolic and bariatric surgery accreditation and quality improvement programme.

Funding, competing interests, data sharing The American College of Surgeons funded this study. See full paper on bmj.com for authors’ disclaimer and data sharing details.

### Perioperative outcomes in propensity score matched cohorts. Values are numbers (percentages) unless stated otherwise

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Concurrent operations (n=6087)</th>
<th>Matched non-concurrent operations (n=6087)</th>
<th>Relative risk (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary outcome†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>5 (0.1)</td>
<td>9 (0.2)</td>
<td>0.56 (0.19 to 1.66)</td>
<td>0.42</td>
</tr>
<tr>
<td>Morbidity</td>
<td>202 (3.3)</td>
<td>184 (3.0)</td>
<td>1.10 (0.90 to 1.34)</td>
<td>0.38</td>
</tr>
<tr>
<td>Unplanned ICU admission</td>
<td>66 (1.1)</td>
<td>65 (1.1)</td>
<td>1.02 (0.72 to 1.43)</td>
<td>1.00</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>24 (0.4)</td>
<td>22 (0.4)</td>
<td>1.09 (0.61 to 1.94)</td>
<td>0.88</td>
</tr>
<tr>
<td>Bleeding</td>
<td>64 (1.1)</td>
<td>72 (1.2)</td>
<td>0.89 (0.64 to 1.24)</td>
<td>0.55</td>
</tr>
<tr>
<td>Reoperation</td>
<td>82 (1.4)</td>
<td>82 (1.4)</td>
<td>1.00 (0.74 to 1.36)</td>
<td>1.00</td>
</tr>
<tr>
<td>Intervention</td>
<td>88 (1.5)</td>
<td>69 (1.1)</td>
<td>1.27 (0.93 to 1.74)</td>
<td>0.15</td>
</tr>
<tr>
<td>Readmission</td>
<td>247 (4.1)</td>
<td>268 (4.4)</td>
<td>0.92 (0.78 to 1.09)</td>
<td>0.37</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>84 (1.4)</td>
<td>75 (1.2)</td>
<td>1.12 (0.82 to 1.53)</td>
<td>0.52</td>
</tr>
</tbody>
</table>

*For secondary outcomes, P values <0.002 are considered significant after Bonferroni adjustment as all secondary outcomes are components of the primary outcome.
†Composite of 30 day death, morbidity, readmission, reoperation, anastomotic or staple line leak, and bleeding events.
‡Morbidity occurred if any one of the following outcomes occurred: surgical site infection, wound disruption, prolonged ventilation, pneumonia, renal failure, urinary tract infection, stroke or CVA, unplanned intubation, peripheral nerve injury, myocardial infarction or CPR, transfusion, sepsis, or venous thrombosis.
Variation in outcome related to male or female surgeons

The sex of the surgeon is unlikely to be relevant

Factors associated with variation in outcome after surgery have been a topic of major interest for the past 20 years. By far the most explored is the relation between case volume and outcome. Hospital and surgeon volumes have been examined in most surgical specialties and related to many short and long term outcomes.

Certainly for more complex procedures, higher institutional volumes correlate with better outcomes. The evidence for individual surgeons is less clear, often reflecting the outcome. Low volume cardiac surgeons, for example, have only slightly higher rates of complications but far higher rates of death in hospital than high volume surgeons.

Comparison of postoperative outcomes among patients treated by male and female surgeons

Wallis CJD, Ravi B, Coburn N, et al
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Study question Do postoperative outcomes for patients undergoing common procedures differ between those treated by male and female surgeons?

Methods This population based, retrospective, matched cohort study identified all patients who had one of 25 common surgical procedures in Ontario, Canada, from 2007 to 2015. Patients treated by a female surgeon were matched to patients who had the same operation by a male surgeon based on patient age, sex, and comorbidity; surgeon volume and age; and hospital. The primary outcome was a composite of death, readmission, or complications. Generalised estimating equations were used to compare outcomes between groups.

Study answer and limitations Among the matched cohort, fewer patients treated by female surgeons experienced the

This study helps to combat these lingering biases by confirming the safety, skill, and expertise of women surgeons relative to their male colleagues

Virtually all studies that examine factors related to surgical outcome are observational. Causal relations are difficult to prove. As a result, programmes to improve quality of care, such as the National Surgical Quality Improvement Programme in the US or Getting It Right First Time in the UK, aim for a better understanding of what those achieving the best outcomes are doing. These elements of best practice can then be incorporated into care at institutions that perform less well.

In the linked paper, Wallis and colleagues looked at variation in outcomes related to being under the care of a male or female surgeon. They found that, for a composite endpoint of complications, readmission rates, or 30 day mortality, female surgeons outperformed male surgeons, with a significant reduction in the rate of this endpoint from 11.6% (6046 of 52 315 patients; 95% confidence interval 11.3% to 11.8%) to 11.1% (5810 of 52 315 patients, 10.9% to 11.4%; adjusted odds ratio 0.96, 0.92 to 0.99).

The authors compared outcomes in more than 100 000 patients after a wide range of operations across many specialties. They went to some lengths not only to match male and female surgeons of similar age and experience but also to match the patients on whom they operated for age, comorbidity, and income.

Clare Marx cmars@rcseng.ac.uk
Derek Alderson
See bmj.com for author details
composite endpoint of death, readmission, or complications (5810 of 52 315, 11.1%, 95% confidence interval 10.9% to 11.4%) than those treated by male surgeons (6046 of 52 315, 11.6%, 11.3% to 11.8%; adjusted odds ratio 0.96, 0.92 to 0.99, P=0.02). Stratified analyses by patient, physician, and hospital characteristics showed no significant effect modification. These findings are subject to the usual biases of observational research, including residual confounding and the inability to capture disease severity or case complexity.

What this study adds After accounting for patient, surgeon, and hospital characteristics, patients treated by female surgeons had significantly lower 30 day mortality than those treated by male surgeons and similar surgical outcomes (length of stay, complications, and readmission).

Funding, competing interests, and data sharing This study was unfunded. CIW is supported by the Canadian Institute of Health Research Banting and Best Doctoral Award. NGC is supported by the Sherif and MaryLou Hanna Chair in Surgical Oncology. RKN is supported by the Amera Family Chair in Urologic Oncology. All authors have completed the ICMJE uniform disclosure form and declare no conflicts of interest. Statistical code is available upon request.

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<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Odds ratio (95% CI)</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardi thoracic surgery</td>
<td>0.91 (0.82 to 1.01)</td>
<td>0.91 (0.82 to 1.01)</td>
</tr>
<tr>
<td>General surgery</td>
<td>0.98 (0.93 to 1.03)</td>
<td>0.98 (0.93 to 1.03)</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>0.95 (0.89 to 1.32)</td>
<td>0.95 (0.89 to 1.32)</td>
</tr>
<tr>
<td>Obstetrics and gynaecology</td>
<td>0.96 (0.87 to 1.05)</td>
<td>0.96 (0.87 to 1.05)</td>
</tr>
<tr>
<td>Orthopaedic surgery</td>
<td>1.00 (0.89 to 1.12)</td>
<td>1.00 (0.89 to 1.12)</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>1.20 (0.81 to 1.79)</td>
<td>1.20 (0.81 to 1.79)</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>0.52 (0.35 to 0.79)</td>
<td>0.52 (0.35 to 0.79)</td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>0.88 (0.66 to 1.29)</td>
<td>0.88 (0.66 to 1.29)</td>
</tr>
<tr>
<td>Urology</td>
<td>0.86 (0.59 to 1.26)</td>
<td>0.86 (0.59 to 1.26)</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>1.00 (1.00 to 1.00)</td>
<td>1.00 (1.00 to 1.00)</td>
</tr>
<tr>
<td>Surgeon age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤60</td>
<td>0.94 (0.88 to 0.99)</td>
<td>0.94 (0.88 to 0.99)</td>
</tr>
<tr>
<td>41-50</td>
<td>1.00 (0.94 to 1.06)</td>
<td>1.00 (0.94 to 1.06)</td>
</tr>
<tr>
<td>51-60</td>
<td>0.94 (0.86 to 1.02)</td>
<td>0.94 (0.86 to 1.02)</td>
</tr>
<tr>
<td>≥61</td>
<td>0.79 (0.60 to 1.03)</td>
<td>0.79 (0.60 to 1.03)</td>
</tr>
<tr>
<td>Years in practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5</td>
<td>0.94 (0.88 to 1.00)</td>
<td>0.94 (0.88 to 1.00)</td>
</tr>
<tr>
<td>5.1-10</td>
<td>0.96 (0.89 to 1.04)</td>
<td>0.96 (0.89 to 1.04)</td>
</tr>
<tr>
<td>10.1-15</td>
<td>0.76 (0.68 to 0.85)</td>
<td>0.76 (0.68 to 0.85)</td>
</tr>
<tr>
<td>≥15</td>
<td>1.06 (1.00 to 1.13)</td>
<td>1.06 (1.00 to 1.13)</td>
</tr>
<tr>
<td>Hospital status</td>
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<tr>
<td>Academic</td>
<td>0.98 (0.93 to 1.03)</td>
<td>0.98 (0.93 to 1.03)</td>
</tr>
<tr>
<td>Community</td>
<td>0.94 (0.90 to 0.99)</td>
<td>0.94 (0.90 to 0.99)</td>
</tr>
<tr>
<td>Patient sex</td>
<td></td>
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</tr>
<tr>
<td>Female</td>
<td>0.96 (0.92 to 1.01)</td>
<td>0.96 (0.92 to 1.01)</td>
</tr>
<tr>
<td>Male</td>
<td>0.95 (0.90 to 1.01)</td>
<td>0.95 (0.90 to 1.01)</td>
</tr>
<tr>
<td>Patient age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-35</td>
<td>0.99 (0.88 to 1.11)</td>
<td>0.99 (0.88 to 1.11)</td>
</tr>
<tr>
<td>36-64</td>
<td>0.98 (0.93 to 1.04)</td>
<td>0.98 (0.93 to 1.04)</td>
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<tr>
<td>≥65</td>
<td>0.92 (0.87 to 0.97)</td>
<td>0.92 (0.87 to 0.97)</td>
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<tr>
<td>Patient comorbidity</td>
<td></td>
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</tr>
<tr>
<td>0-5</td>
<td>0.94 (0.87 to 1.01)</td>
<td>0.94 (0.87 to 1.01)</td>
</tr>
<tr>
<td>6-7</td>
<td>1.01 (0.93 to 1.10)</td>
<td>1.01 (0.93 to 1.10)</td>
</tr>
<tr>
<td>8-10</td>
<td>0.94 (0.88 to 1.01)</td>
<td>0.94 (0.88 to 1.01)</td>
</tr>
<tr>
<td>≥11</td>
<td>0.95 (0.88 to 1.02)</td>
<td>0.95 (0.88 to 1.02)</td>
</tr>
<tr>
<td>Surgeon volume (quartiles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - low</td>
<td>0.96 (0.90 to 1.02)</td>
<td>0.96 (0.90 to 1.02)</td>
</tr>
<tr>
<td>1</td>
<td>0.99 (0.92 to 1.06)</td>
<td>0.99 (0.92 to 1.06)</td>
</tr>
<tr>
<td>2</td>
<td>0.95 (0.87 to 1.04)</td>
<td>0.95 (0.87 to 1.04)</td>
</tr>
<tr>
<td>3 - high</td>
<td>0.92 (0.84 to 1.01)</td>
<td>0.92 (0.84 to 1.01)</td>
</tr>
</tbody>
</table>

Likelihood of adverse postoperative outcomes (death, readmission, or complications) among patients treated by female and male surgeons, stratified by physician, patient, and hospital factors

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**Short term difference**

The reported difference in short term outcomes may be statistically significant, but is it biologically sound or clinically meaningful? Patients undergoing these procedures tend to focus on long term outcomes. Patients who have elective arthroplasty, for example, are concerned with pain relief and subsequent return to physical activity, and patients with cancer tend to focus on the risks of recurrence and long term survival.

Secondary analyses of the individual components of the composite primary outcome are enlightening. Wallis and colleagues report no difference between male and female surgeons in readmissions or complications, but they do report a significantly lower 30 day mortality among patients managed by female surgeons (adjusted odds ratio 0.88, 0.79 to 0.99, P=0.04). The authors acknowledge, however, that their observational study has many of the usual shortcomings and warn that, as the small differences in outcome reported after elective surgery disappeared in retrospective analyses of emergency operations, the headline reduction in 30 day mortality associated with female surgeons is probably due to unmeasured confounding factors.

Surgery is a specialty that continues to struggle with unconscious bias among patients and health professionals, and sex inequality persists. In this large Canadian study only 23.4% of surgeons were female, and only 12.4% of patients were treated by women. This study helps to combat these lingering biases by confirming the safety, skill, and expertise of women surgeons relative to their male colleagues.

**Improving surgical outcomes is a complex undertaking.** Surgeons and researchers tend to focus on physical and clinical endpoints, often failing to acknowledge the importance of the social and emotional outcome after surgery. Hospital providers are more concerned with cost effectiveness and efficiency savings than community costs. With so many critical factors to consider, trying to find out why there is a very small difference in short term clinical outcomes between male and female surgeons is unlikely to prove worthwhile. Nor are we convinced that the sex of the surgeon will emerge as an important determinant of a good outcome for patients having surgery.

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Four design principles for genetic studies using next generation sequencing

Mason CC

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Next generation sequencing is now commonly used for the genetic assessment of many diseases. It has a powerful capacity to evaluate nearly all genetic loci simultaneously, so clinician investigators might be appropriately drawn to its use in their research. Clinicians new to next generation sequencing should be aware that despite its attractiveness, it does have limitations and design related problems that can result in biases that obscure the appraisal of hypotheses. These obstacles can be overcome with good study design.

This article discusses four key design principles: similar assessment of cases and controls, randomisation, achieving sufficient sequencing depth, and determining an adequate sample size to test hypotheses at adjusted significance levels. Several examples of next generation sequencing for evaluating genetic factors in disease cohorts are discussed, with consideration of the correct application of the design principles and what might happen if they are ignored.

Next generation sequencing relies on the assessment of many genetic molecules to identify the nucleotides and frequency of a particular genetic sequence. The greater the number of assessments—often referred to as the sequencing depth—the more confident (and costly) the study will be. One example details the identification of de novo mutations in a paediatric disease cohort by combining multiple samples to reduce cost (multiplexing), while still achieving sufficient depth to test the genetic hypothesis. Combining too many samples can result in substantial portions of the targeted genetic region being undersequenced, potentially missing variants of interest.

Applying the study design principles outlined in the article could improve assessment of experimental hypotheses, leading towards future improvements in human health.

Combining samples to reduce costs (multiplexing) can cause insufficient sequencing depth at some genetic loci. In this example, running four, three, or two samples per lane results in 35%, 60%, or 95% of bases in the target region achieving the required depth of ≥20 reads.