Differences in acute general surgical admissions between obese or overweight patients compared to normal-sized patients

Richard Flint

ABSTRACT

AIM: Obesity is changing the pattern of modern health and illness. Despite its adverse effect on medical ailments such as diabetes and ischaemic heart disease, its effect on acute general surgical conditions is unknown. This study aims to determine the effect that excess weight and obesity have on acute general surgical conditions.

METHODS: A prospective observational cohort study comparing the pattern of acute general surgical admissions in patients with a BMI >25 kg/m² to those with a normal BMI from a single tertiary-level hospital.

RESULTS: There were 2,676 (21.5%) patients who were overweight or obese (mean BMI 32.4 ± 6.3 kg/m²). These patients were significantly younger than those with normal BMI (48.3 ± 18.1 years versus 50.5 ± 22.4 years; p<0.0001). They had a shorter average hospital stay (2.9 ± 4.2 compared to 3.2 ± 5.0 days; p=0.14). However, more overweight patients required a visit to theatre (34% compared to 29%; p<0.0001, OR 1.25 (1.14 to 1.37; 95% CI)). Overweight patients were more likely to suffer from biliary conditions (13% compared to 8%; p=0.0001; OR 1.84 (1.60–2.10)) and pancreatitis (6% compared to 4%; p=0.0001; OR 1.71 (1.42 to 2.06)). In contrast, they were less likely to present with bowel obstruction (4% compared to 6%; p<0.0001, OR 0.63 (0.5 to 0.78)) or GI bleeding (4% compared to 6%; p<0.0001; OR 0.64 (0.51 to 0.79)).

CONCLUSIONS: Overweight or obese patients present at a younger age and with a higher predominance of gallstone related diseases.

Obesity is considered the greatest health risk of the modern era. The relationship between obesity and co-morbidities that lead to early mortality has been well established. Indeed, there is direct evidence for a causal relationship between body mass index (BMI) and medical conditions such as diabetes, vascular diseases, and certain cancers. This leads to an increased rate of hospital admission for obese patients with diagnoses of ischaemic heart disease, stroke, and venous thromboembolism. Yet these tend to be medical conditions, and the effect of obesity on surgical admissions has only been intimated. For example, it is known that obesity predisposes to gallstone disease, diverticulitis, and paraesophageal hernia. However, the significance of this on the composition of acute surgical admissions is yet to be clarified.

This current study investigates the hypothesis that obesity, or excess weight, alters the pattern of acute surgical diseases by assessing all admissions to the Surgical Assessment and Review (SARA) unit of Christchurch Hospital, New Zealand. This hospital is a 650+ bed institution that services a population of 514,680 people. The age-standardised prevalence of obesity (Class II, BMI >40 kg/m²) in this population is 26.3%; that is equivalent to the national prevalence (29.1%; p=0.06). All patients older than 16 years presenting to this hospital with acute general surgical conditions (excluding trauma) are admitted to the SARA unit. Here, the treatment is initiated before they are admitted to a general surgical ward or discharged from the hospital. This current study is a prospective audit of the admissions to the SARA unit.
to determine any differences between those that are overweight and those with a normal BMI.

**Methods**

All patients that were admitted to the SARA unit between 1 January, 2012 and 7 March, 2014, were identified from a prospective database. Patient demographics (age, gender, race, body mass index (BMI)), duration of stay, theatre visits, and outcomes (type of discharge or death) were recorded. Patients were considered overweight or obese if their BMI was greater than 25 kg/m$^2$. The discharge diagnosis was recorded and only one diagnosis was credited to each patient (eg, a patient with gallstone pancreatitis was not counted as biliary condition and again as pancreatitis). The definitions are as follows:

- **Non-specific abdominal pain:** acute abdominal pain less than 7 days duration that resolved spontaneously with no diagnosis after exam and baseline investigations.
- **Appendicitis:** operative or radiological confirmation of inflamed appendix.
- **Biliary conditions:** biliary colic, cholangitis, or cholecystitis with radiographic evidence of gallstones.
- **Pancreatitis:** abdominal pain with amylase $>1000$ iU or radiographic evidence of pancreatic inflammation irrespective of cause.
- **Neoplasm:** any neoplasm arising from a visceral organ or intra-abdominal structure.
- **Gastrointestinal bleeding:** presentation with melena, haematemesis, or haematochezia, irrespective of endoscopic or radiologic findings.
- **Diverticulitis:** abdominal pain with acute constipation or diarrhoea, fever or leucocytosis, with either radiographic evidence of inflamed diverticula or a past history of diverticulitis.
- **Bowel obstruction:** abdominal colic with radiographic evidence of small or large bowel distension.
- **Gastroenteritis:** abdominal pain with diarrhoea and/or vomiting, with either positive stool cultures or self-limiting course.
- **Peptic ulcer disease:** abdominal pain with endoscopic evidence of peptic ulcer.
- **Haemorrhoids:** internal or external haemorrhoids grade 1–4, thrombosis or prolapsed.
- **Cutaneous abscess:** subdermal abscess on trunk requiring incision and drainage.
- **Hernia:** incarceration of strangulation of a viscous through the abdominal wall as assessed by examination or radiology.

Length of stay was measured as the difference between the time of discharge from hospital (SARA or hospital ward) and the time of admission to hospital (either emergency department or SARA). It was calculated as total hours and converted to days for purpose of description.

All descriptive data is expressed as mean ± standard deviation. All statistical analysis was performed by Prism for Mac OS X version 6.0f (GraphPad Software Inc., San Diego, USA. Student's two-tailed t-test (non-paired) was used to analyse all nonparametric data and chi-squared with Yates's correction for all parametric data. Association was analysed by odds ratio, and expressed with 95% confidence interval.

This study was performed in accordance with the ethical standards of the National Ethics Advisory Committee of New Zealand that adheres to those of the 1964 Helsinki declaration and its later amendments.

**Results**

There were 12,429 patients (5,418 male; mean age 50.0 ± 21.6 years) admitted to the SARA unit in the 26-month study period (Table 1). The majority of patients were European (86.5%), with the next most prevalent race being Māori (6.4%). The average stay in hospital was 3.1 ± 4.8 days with 3,737 (30%) patients requiring at least one operation during their admission. Nearly all admissions ended with a routine discharge (11,873 patients; 95.5%) with 323 patients (2.6%) requiring transfer to another hospital, and 141 (1.1%) self-discharging. There were 92 (0.7%) deaths during the study period.
### Table 1: Patient demographics and outcomes of patients admitted to SARA between January 2012 and March 2014. Patients are categorised into three groups, all patients (All), those patients with a normal weight (Normal), and those who were overweight or obese (BMI >25 kg/m²). Percentages refer to the proportion of patients within each group. NS: non-significant.

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Normal</th>
<th>BMI &gt;25 kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>12,429</td>
<td>9,753</td>
<td>2,676</td>
</tr>
<tr>
<td>Age (mean ± SD; years)</td>
<td>50.0 ± 21.6</td>
<td>50.5 ± 22.4</td>
<td>48.3 ± 18.1</td>
</tr>
<tr>
<td>Male</td>
<td>5,418 (44%)</td>
<td>4,254 (44%)</td>
<td>1,164 (44%)</td>
</tr>
<tr>
<td>European</td>
<td>10,754 (87%)</td>
<td>8,473 (87%)</td>
<td>2,281 (85%)</td>
</tr>
<tr>
<td>Māori</td>
<td>790 (6%)</td>
<td>571 (6%)</td>
<td>219 (8%)</td>
</tr>
<tr>
<td>Asian</td>
<td>415 (3%)</td>
<td>356 (4%)</td>
<td>59 (2%)</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>264 (2%)</td>
<td>186 (2%)</td>
<td>78 (3%)</td>
</tr>
<tr>
<td>Other</td>
<td>206 (2%)</td>
<td>177 (2%)</td>
<td>39 (2%)</td>
</tr>
<tr>
<td>Operations</td>
<td>3,737 (30%)</td>
<td>2,831 (29%)</td>
<td>906 (34%)</td>
</tr>
<tr>
<td>Routine discharge</td>
<td>11,873 (96%)</td>
<td>9,272 (95%)</td>
<td>2,601 (97%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>92 (0.7%)</td>
<td>87 (0.9%)</td>
<td>5 (0.2%)</td>
</tr>
</tbody>
</table>

### Table 2: Discharge diagnoses of patients admitted to SARA between January 2012 and March 2014. Patients are categorised into three groups: all patients (All), patients with normal weight (Normal), and those overweight or obese (BMI >25). Percentages refer to the proportion of patients within each group. Statistical comparison is between normal and BMI >25 within each diagnosis. NS: non-significant; OR: odds ratio.

<table>
<thead>
<tr>
<th>Discharge diagnosis</th>
<th>All N=12,429</th>
<th>Normal N=9,753</th>
<th>BMI &gt;25 N=2,676</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSAP*</td>
<td>2,006 (16%)</td>
<td>1,521 (16%)</td>
<td>485 (18%)</td>
<td>P&lt;0.002; OR=1.1 (1.1–1.3)</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>1,095 (9%)</td>
<td>900 (9%)</td>
<td>195 (7%)</td>
<td>P&lt;0.002; OR=0.8 (0.7–0.9)</td>
</tr>
<tr>
<td>Biliary</td>
<td>1,099 (9%)</td>
<td>746 (8%)</td>
<td>353 (13%)</td>
<td>P&lt;0.001; OR=1.8 (1.6–2.1)</td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>674 (5%)</td>
<td>573 (6%)</td>
<td>101 (4%)</td>
<td>P&lt;0.001; OR=0.6 (0.5–0.8)</td>
</tr>
<tr>
<td>GI bleeding*</td>
<td>634 (5%)</td>
<td>538 (6%)</td>
<td>96 (4%)</td>
<td>P&lt;0.001; OR=0.6 (0.5–0.8)</td>
</tr>
<tr>
<td>Diverticulitis</td>
<td>620 (5%)</td>
<td>464 (5%)</td>
<td>156 (6%)</td>
<td>P&lt;0.001; OR=1.4 (1.2–1.7)</td>
</tr>
<tr>
<td>Perianal abscess</td>
<td>617 (5%)</td>
<td>460 (5%)</td>
<td>157 (6%)</td>
<td>P=0.018; OR=1.3 (1.1–1.5)</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>576 (5%)</td>
<td>411 (4%)</td>
<td>165 (6%)</td>
<td>P&lt;0.001; OR=1.7 (1.4–2.1)</td>
</tr>
<tr>
<td>Hernia</td>
<td>411 (3%)</td>
<td>300 (3%)</td>
<td>111 (4%)</td>
<td>P=0.007; OR=1.4 (1.1–1.7)</td>
</tr>
<tr>
<td>Gastroenteritis</td>
<td>384 (3%)</td>
<td>327 (3%)</td>
<td>57 (2%)</td>
<td>P=0.002; OR=0.6 (0.5–0.8)</td>
</tr>
<tr>
<td>Neoplasm</td>
<td>342 (3%)</td>
<td>291 (3%)</td>
<td>51 (2%)</td>
<td>P=0.003; OR=0.6 (0.5–0.9)</td>
</tr>
<tr>
<td>Cut abscess*</td>
<td>325 (3%)</td>
<td>230 (2%)</td>
<td>95 (4%)</td>
<td>P=0.001; OR=1.5 (1.1–1.9)</td>
</tr>
<tr>
<td>PUD*</td>
<td>199 (3%)</td>
<td>170 (2%)</td>
<td>29 (1%)</td>
<td>P=0.020; OR=0.6 (0.4–0.9)</td>
</tr>
<tr>
<td>Haemorrhoids</td>
<td>75 (3%)</td>
<td>63 (0.6%)</td>
<td>12 (0.4%)</td>
<td>P=NS; OR=0.7 (0.4–1.3)</td>
</tr>
</tbody>
</table>

*BMl is measured as kg/m²; NSAP: non-specific abdominal pain; GI bleeding: gastrointestinal bleeding; Cut abscess: cutaneous abscess; PUD: peptic ulcer disease.
There were 2,676 (21.5%) patients who were coded as overweight or obese. The precise BMI had not been charted in 322 patients. The mean BMI for the overweight or obese group was 32.4 ± 6.3 kg/m². These patients were significantly younger than those with normal BMI (48.3 ± 18.1 years compared to 50.5 ± 22.4 years; p<0.0001), but there was no differences in gender. Pacific peoples and Māori represented the groups with the highest proportion of overweight patients (30% of all Pacific peoples and 28% of all Māori admitted). Asian people had the least proportion of overweight patients (14%).

The average stay in hospital for the group of overweight patients was significantly shorter than those with a normal BMI (2.9 ± 4.2 compared to 3.2 ± 5.0 days; p=0.14). Similarly, the mortality was less in the overweight group (5 overweight patient deaths (0.2%) compared to 87 normal BMI patient death (0.9%); p=0.0003, OR 0.21 (0.08 to 0.51). This was in contrast to the rate of operations with a greater proportion of overweight patients requiring a visit to theatre (34% of overweight patients compared to 29% of normal BMI patients; p<0.0001, OR 1.25 (1.14 to 1.34).

The diagnosis appeared to have greater uncertainty in overweight patients, as they were more likely to be discharged with a finding of non-specific abdominal pain (18% compared to 16%; p=0.0018, OR=1.20 (1.07 to 1.34)) (Table 2). For the remainder, there was a different diagnostic spectrum when compared to the normal BMI group. Overweight patients were more likely to suffer from biliary conditions (13% compared to 8%; p< 0.0001; OR 1.84 (1.60 to 2.10)) and pancreatitis (6% compared to 4%; p<0.0001; OR 1.71 (1.42 to 2.06). Similarly they were more likely to suffer from suppurrative conditions (eg, cutaneous abscess, perianal abscess and diverticulitis) except for appendicitis. In contrast, overweight patients were less likely to present with bowel obstruction (4% compared to 6%; p<0.0001, OR 0.63 (0.51 to 0.78)), or GI bleeding (4% compared to 6%; p<0.0001; OR 0.64 (0.51 to 0.78)).

**Conclusion**

This study compares a cohort of overweight and normal-sized patients admitted with acute general surgical conditions over a 26-month period. It describes a different spectrum of diseases between the two groups, where overweight patients are more likely to present at a younger age, present biliary conditions, and have greater chance of requiring operative intervention.

In 1989, Irvin et al described an audit of 1,190 acute general surgical admissions where the most frequent diagnoses were appendicitis and bowel obstruction. Gallstone-related disease only accounted for 5% of admissions at that time. More recent audits have hinted at a changing pattern of ailments, with gallstone-related disease accounting for 7% to 12% of all general surgical admissions. It has long been known gallstone formation is enhanced in the obese population and occurs at a younger age. This current study suggests the increasing number of younger patients with gallstone-related problems is a reflection of the rising prevalence of obesity in the community, and indicates a changing pattern of acute surgical illness.

Current management of gallstone-related disease focuses on early operative intervention and acute cholecystectomy is the standard practise in our unit. This may explain why more overweight patients were admitted to the operating room in this current study. This increased demand on theatre access has significant implications when considering hospital resourcing in the future. Not only will overweight patients require more theatre access, but also lengthier theatre time as operations in this patient group takes significantly longer to complete. This may place strain on our fixed resource health system similar to what has already been described in other countries. It may be argued, however, that these problems may be offset by our findings of a reduced length of stay in overweight patients. Yet complications common to obese patients, such as wound infections, have not been captured in this audit and must be factored in when allocating resources. Furthermore, this reduced length of stay may be a feature of a younger population, and this effect will not persist as the obese generation get older.

Our study has also highlighted the difficulties in assessing overweight patients to arrive at a diagnosis. Nonspecific abdominal pain was the most common
reason for admission, but at a higher level in the overweight patients. Although a clear diagnosis cannot be derived on initial presentation, recent studies suggest at least a third have a conventional cause that becomes apparent at a later date. Unfortunately, this current study was unable to assess the level of investigations that were used in this group, or the readmission rate. But it is likely that considerable resources are needed to establish a future diagnosis, with other reports revealing that 58% of these patients require further imaging, and 12% need endoscopy. These delays in diagnosis can lead to increased morbidity. This is best illustrated in studies on appendicitis, where complications are more likely to occur in those with delayed treatment. This is not insignificant considering 3% of patients (60 patients, if extrapolated to this current study) who have been diagnosed with non-specific abdominal pain will have appendicitis.

Despite these concerns, there is room for optimism. A surprising finding in this current study is that the proportion of overweight patients admitted to hospital did not mirror the proportion found in the population. It is estimated that 62% of adult New Zealanders are overweight or obese, yet only 22% of patients in this current study had a raised BMI. Obesity is a well-established base for poor health, and a leading cause of preventable death, yet this may become more of a problem for the medical, rather than surgical, communities. It is beyond the scope of this current study to extrapolate the findings as proof that obesity modulates acute abdominal conditions. Yet it is tempting to postulate how this may be true. It has been well established that adipose tissue is not inert, but a prolific producer of inflammatory and immunological cytokines and peptides. Omentum is rich in adipocytes and has long been regarded as the ‘abdominal policeman’ that promotes healing and controls infection by its rich production cytokines. The hypothesis that obesity increases omental fat that modulates intrabdominal diseases can be supported by findings of a reduced perforation rate in obese children with appendicitis.

This current study also showed that bowel obstruction was observed less often in overweight patients. Small bowel obstruction is nearly always a result of prior surgery, but may occur several months after the initial operation. Studies evaluating immediate postoperative complications have found no influence from obesity, but long-term outcomes are often missing. The findings from this current study may give a clue to a prolonged effect of obesity in surgery. Possible mechanisms that lead to a reduced small bowel obstruction may include a reduction of adhesion formation from cytokine modulation as theorised above. Or the increased bulkiness of the adipose mesentery may restrict small bowel mobility that limits twisting of the bowel. If true, this could be a source of further optimism, as adhesive small bowel obstruction is a resource heavy condition. For example, a large British audit showed patients with adhesive small bowel obstruction spent an average of one week in hospital, if treated conservatively. Unfortunately, two-thirds required an operation that lengthened the stay to an average of 16 days. However, the current findings may be unrelated to a change in pathology and may just reflect a younger population that have not had prior surgery. For example, trials of bariatric surgery found that postoperative bowel obstruction was not an uncommon finding, occurring at a rate similar to other surgeries—no matter if the approach was laparoscopic or open.

Although this current study indicates a different pattern of acute surgical illness in overweight patients, the results need to be considered in view of its limitations. There was no ability to adequately assess the level of co-morbidities between the two cohorts. It is conceivable that the overweight group had a greater level of diabetes, which would have influenced the proportion of patients with suppurative conditions, such as pilonidal disease. Furthermore, it is likely that the overweight group have had less prior surgery given their younger age. This would make bowel obstruction less likely and may have confounded the results. It was also beyond the scope of this current study to evaluate the various types of operations between each group, and the effect of postoperative complications on the final results. For example, the overweight group had less bowel obstruction, so would...
be expected to have had less laparotomies, which require several days recuperation before discharge. Finally, there was no ability to follow patients beyond discharge, so longer term outcomes and diagnosis cannot be determined.

In conclusion, this current study compares a cohort of overweight or obese patients with normal-sized patients who were admitted with acute general surgical conditions. Overweight or obese patients appear to present with a different spectrum of disease at a younger age. Gallstone-related diseases dominate this spectrum and may be responsible for a greater operative intervention. This has repercussions when planning resources for the future. However, the proportion of overweight patients presenting with acute surgical conditions do not match the rate of excess weight/obesity that is found in the community. This may not persist, as the obese younger generation gets older. Alternatively, it may indicate that obesity modulates acute surgical diseases and leads to tantalising theories about the complex role that adipose tissue may have on these age-old surgical ailments.

**Competing interests:** Nil

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