Bariatric surgery: A systematic review and network meta-analysis of randomized trials

CRD summary
The review concluded that bariatric surgery appeared substantially more effective than standard care for the treatment of severe obesity in adults. However, large and adequately powered, long-term RCTs were lacking. Based on the limited evidence available, the authors advised a cautious interpretation of their conclusions, which appear likely to be reliable.

Authors' objectives
To assess the clinical efficacy and safety of bariatric surgical interventions and standard care in adult patients with severe obesity.

Searching
MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched to February 2009 without language and publication restrictions. A basic PubCrawler alert was run until March 2010. A search strategy was provided as an appendix. Trial registries, HTA websites and systematic review reference lists were searched for additional studies. Manufacturers were also contacted.

Study selection
Eligible studies were randomised controlled trials that compared types of bariatric surgery with each other, or with standard care Participants were severely obese adults (16 years or older) with an accepted indication for bariatric surgery (Body Mass Index (BMI) 40kg/m$^2$ or greater) or BMI 35kg/m$^2$ or greater with at least one obesity-related comorbidity. In trials that did not report BMI criteria, the paper reported further criteria to assess eligibility for the review). Studies had to report at least one of: weight change (the primary outcome was change in BMI), all-cause mortality, control of comorbidities, hospitalisation, re-operations, gastrointestinal disturbances and serious surgical sequelae.

Eight different types of surgery were studied across the included trials, with vertical banded gastroplasty, gastric bypass and adjustable gastric banding being studied most frequently. Only four studies used standard care (with varying definitions). Although not always reported, around half the studies used open surgery and around a quarter used laparoscopic techniques (a few trials used a combination). Participant mean ages ranged from 30 to 48 years and the percentage of female participants from 44% to 97%. Mean baseline BMI ranged from 42 to 58kg/m$^2$.

Two reviewers independently selected studies for inclusion, with full paper disagreements resolved by discussion with a third reviewer.

Assessment of study quality
Study quality was evaluated by assessing randomisation technique, double-blinding and description of withdrawals/drop-outs to produce a Jadad score that ranged from one to five. Allocation concealment, funding sources, a priori sample size calculations, interim or preliminary analyses, intention-to-treat designs and reports of surgical sequelae were also assessed.

Two reviewers independently assessed study quality, with disagreements resolved by discussion with a third reviewer.

Data extraction
Data were extracted to calculate risk ratios (RR) or risk differences (RD) for dichotomous outcomes, and mean differences (MD) for continuous outcomes with 95% confidence intervals. Adverse events were evaluated at early (30 days or less) or late (more than 30 days) time points.

One reviewer extracted data which were then checked by a second reviewer.

Methods of synthesis
Pairwise meta-analyses were conducted using a random-effects model with heterogeneity assessed using $I^2$. Network
meta-analysis was performed (using Markov chain Monte Carlo methods within a Bayesian framework) to analyse change in BMI between different interventions, with 95% credible intervals (CrI) also reported. Interventions were then ranked by efficacy for reducing BMI. Incoherence was quantified using Bucher's method. Network meta-analysis utilises both direct evidence (treatments compared in the same trial) and indirect evidence (different treatments studied in separate trials, but sharing a common comparator treatment).

**Results of the review**

Thirty-one RCTs were included (2,619 patients, range 16 to 310). The median duration of follow-up was 24 months (range six to 60 months). In general, the authors considered that most studies had been poorly conducted. Over half the studies scored 1 point on the Jadad scale, with most of the remainder scoring 2 or 3. Four out of 31 used intention-to-treat data, although there was adequate reporting of adverse events in most trials.

**Network meta-analysis:** The differences in BMI levels from baseline at year one (15 RCTs; 1,103 participants), compared with standard care were statistically significant for: mini-gastric bypass (MD –11.3kg/m\(^2\), 95% CrI -18.6 to -4.1); biliopancreatic diversion (MD –11.2kg/m\(^2\), 95% CrI -15.7 to -6.9); sleeve gastrectomy (MD –10.1kg/m\(^2\), 95% CrI -17.8 to -2.6); and Roux-en-Y gastric bypass (MD –9.0kg/m\(^2\), 95% CrI -15.1 to -3.1). Results were not statistically significant for: jejunoileal bypass (MD –11.4kg/m\(^2\), 95% CrI -23.0 to 0.8); horizontal gastroplasty (MD –6.4kg/m\(^2\), 95% CrI -12.9 to 0.01); and adjustable gastric banding (MD –2.4kg/m\(^2\), 95% CrI -9.1 to 3.9). Jejunoileal bypass was the highest ranked intervention in terms of the probability of it being the best intervention (p=0.40). Weight losses were highest with diversionary procedures, intermediate with diversionary/restrictive procedures, and lowest with those which were purely restrictive. Results for the two (11 RCTs) and three-to-five (seven RCTs) year time points were also reported.

**Pairwise meta-analyses:** There were significantly shorter lengths of stay in hospital for patients who received adjustable gastric banding compared with those patients receiving Roux-en-Y gastric bypass (two RCTs) or vertical banded gastroplasty (three RCTs). More results were reported, mostly of comparisons involving one or two trials.

**Authors' conclusions**

Although high quality data from large, adequately powered, long-term RCTs were lacking, bariatric surgery appeared substantially more effective than standard care for the treatment of severe obesity in adults.

**CRD commentary**

The review addressed a clear question and was supported by appropriate inclusion criteria. Attempts to identify all relevant studies in any language were undertaken by searching electronic databases and relevant websites, and by checking references. Suitable methods were employed to reduce the risks of reviewer error and bias throughout the review.

Study quality was assessed and was used in interpreting the results of the review. Sufficient study details were provided and appropriate methods were used to pool data (network meta-analysis methods were used to analyse the primary outcome of weight change) and to assess and investigate heterogeneity. It was evident that most of the included trials may have been subject to bias and underpowered, and the authors’ appropriately advised caution when interpreting the strength of their conclusions, which appear likely to be reliable.

**Implications of the review for practice and research**

**Research:** The authors stated that more studies were required to directly compare the clinical benefits of different surgical procedures on clinically relevant outcomes over long follow-up periods (especially for newer procedures types). Studies that examine the relative benefit of bariatric surgery in different subpopulations (such as obesity-related comorbidities, older or younger patients), and the impact of more versus less selective approaches for patient selection should also be a high priority.

**Practice:** The authors stated that their results implied that the choice between the two most commonly performed surgeries (Roux-en-Y gastric bypass and adjustable gastric banding) was a trade-off between safety and efficacy, and that their results may have been helpful to patients and providers when making decisions regarding the type of surgery to undergo or perform. They added that the network meta-analysis results may have been useful for providing a perspective on the relative efficacy of the interventions.
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