A meta-analysis of randomised controlled trials on preoperative oral carbohydrate treatment in elective surgery
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CRD summary
This review concluded that carbohydrate treatment may be linked to attenuation of insulin resistance and reduced length of stay in patients who undergo abdominal surgery. These conclusions appear suitably cautious and reliable. However, reduction in length of stay in patients undergoing abdominal surgery may not be as robust as suggested because of imprecision, heterogeneity and multiple testing.

Authors' objectives
To assess the effects of preoperative carbohydrate treatment on length of hospital stay and other clinical outcomes among patients undergoing elective surgery.

Searching
MEDLINE, EMBASE, Science Citation Index and The Cochrane Library were searched from January 1980 to April 2012, with no language restrictions. Search terms were reported. Bibliographies of published randomised controlled trials were handsearched for additional studies. Manufacturers of preoperative carbohydrate drinks were contacted for any unpublished data.

Study selection
Prospective studies that randomised adult, non-diabetic patients undergoing elective surgery to preoperative carbohydrate treatment (50 or more grams of oral carbohydrate, given two to four hours before anaesthesia) or control (fasting/placebo) were eligible for inclusion. The primary outcome of interest was length of hospital stay (defined as number of postoperative days in hospital, until discharge). Secondary outcomes included the development of postoperative insulin resistance, and the occurrence of drink-related and postoperative complications, postoperative nausea and vomiting.

The included studies were published between 1998 and 2012. Mean ages of patients were 55 years in the treatment group and 54 years in the control group. Types of elective surgery received included open major colorectal surgery, total hip replacement, cardiac surgery, open and laparoscopic cholecystectomy, thyroid surgery, major open abdominal surgery, unilateral inguinal hernia repair and orthopaedic surgery.

Two reviewers independently selected studies for inclusion.

Assessment of study quality
Study quality was assessed according to patient selection, comparability of the study groups, outcome measures used, randomisation methods, allocation concealment, blinding, protocol violation, and description of withdrawals/drop-outs. GRADE criteria were applied to assess the strength of the evidence. Multiple reviewers performed the assessment; any disagreements were resolved by discussion with two other reviewers.

Data extraction
Data on the outcomes were extracted to calculate mean differences and 95% confidence intervals for data on length of hospital stay, and risk ratios and 95% confidence intervals for data on surgical complication rates. Corresponding authors were contacted for additional or missing data when necessary. It was unclear how many reviewers extracted data.

Methods of synthesis
Effect estimates and their 95% confidence intervals were pooled using a fixed-effect model, or a random-effects model in the presence of heterogeneity. Statistical heterogeneity between studies was assessed using $\chi^2$ and $I^2$ statistics ($I^2$ values of 25% indicated low heterogeneity, 50% indicated moderate heterogeneity and 75% indicated high heterogeneity). A priori subgroup analyses were performed in all patients who underwent preoperative carbohydrate...
treatment, patients who underwent major abdominal surgery, those who underwent operative procedures with an expected length of stay of two days or less, and those who underwent orthopaedic surgery. Any outcomes that were not synthesised statistically were synthesised narratively. Funnel plots were used to provide a visual assessment of potential publication bias.

**Results of the review**

Twenty-one randomised controlled trials were included in the review (1,685 patients). All but one of the trials defined their inclusion and exclusion criteria. Fifteen trials adequately reported randomisation methods, nine trials described allocation concealment, 17 performed either single or double blinding, and withdrawals and drop-outs were described in 14 trials. Two trials followed-up patients to one month post-discharge; the remainder followed-up patients to hospital discharge.

No statistically significant differences in length of hospital stay were found between the treatment and control groups overall (MD -0.19, 95% CI -0.46 to 0.08; 12 trials; I²=83%); similar results were found among the trials whose treatment groups underwent operative procedures with an expected length of stay of two days or less. A statistically significant reduction in length of hospital stay was found among patients who received preoperative carbohydrate treatment prior to open abdominal surgery, compared with controls (MD -1.08, 95% CI -1.87 to -0.29; seven trials; I²=60%). A small but statistically significant increase in length of hospital stay was found among patients who received preoperative carbohydrate treatment prior to orthopaedic surgery, compared with controls (MD 0.48, 95% CI 0.23 to 0.73; two trials; I²=0%). The strength of the evidence was low for the primary meta-analysis and moderate for each of the subgroup analyses.

Six of the seven trials that assessed the development of postoperative insulin resistance found statistically significant lower rates in the treatment groups, compared with controls. No statistically significant differences between groups were found for postoperative complications (RR 0.88, 95% CI 0.50 to 1.53; nine trials; I²=41%); most of these studies did not continue follow-up after hospital discharge, and the strength of the evidence was low. Mixed results were reported in relation to postoperative nausea and vomiting (five trials). No evidence of publication bias was found, and no occurrences of drink-related pulmonary complications were reported.

**Authors' conclusions**

Preoperative carbohydrate treatment may be linked to a reduced length of stay in patients who undergo major abdominal surgery, and attenuation of insulin resistance in all patients. However, the strength of the evidence was low to moderate.

**CRD commentary**

The review question and inclusion criteria were clearly defined. Attempts were made to locate both published and unpublished data from various sources, and no language restrictions were applied during study selection. Efforts were also taken to minimise reviewer error and bias for the processes of study selection and quality assessment, though this was unclear for the process of data extraction. Suitable quality assessment criteria were employed; the results were variable across the included trials. The methods of synthesis were appropriate, although the inclusion of two very different treatments (fasting and placebo) as the control condition may have contributed to the heterogeneity observed in the meta-analyses. The authors acknowledged that the included trials had small sample sizes, and that there were differences between them with regards to definitions of outcomes and assessment methods for insulin resistance. They also acknowledged that the strength of the evidence ranged from low to moderate, due to imprecision and/or risk of bias.

Given the limitations of the evidence base, the authors’ conclusions regarding the reliability of the evidence appear suitably cautious. However, the apparent reduction in length of hospital stay amongst the subgroup of patients undergoing abdominal surgery may not be as robust as the authors suggest because of imprecision, heterogeneity, potential for risk of bias and problems associated with multiple testing.

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

Practice: The authors stated that preoperative use of oral complex carbohydrate drinks of appropriate osmolality appears safe, and that faster recovery (decreased length of hospital stay) might occur in patients undergoing open major abdominal surgery.
Research: The authors stated that well-designed randomised controlled trials were needed to study the impact of preoperative carbohydrate surgery on postoperative recovery, and to determine which patient groups would likely benefit most. Further suggestions were made in relation to patient groups, confounding factors, and perioperative wellbeing.

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