



Perioperative Carbohydrate Loading and Enhanced Recovery: Where the Nutritional Component Actually Contributes

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Abstract

Enhanced recovery programmes reduce length of stay by up to 30 per cent and complications by as much as 50, and preoperative carbohydrate loading is one of their numerous components. Attributing the programme effect to the drink is the error this review examines. Guidelines recommend loading strongly while stating that the quality of underlying evidence remains low or moderate. A Bayesian network meta-analysis found low-dose oral carbohydrate associated with reduced postoperative infection at 0.42 (95% CrI 0.20 to 0.81), and no significant difference from control in the other outcomes examined, concluding that there is no evidence the drink alleviates patient discomfort. A review of six randomised trials found loading consistently safe, with no delayed gastric emptying or aspiration, while effects on length of stay and complications remained variable. Safety is the most reproducible finding.

Keywords: Carbohydrate loading; Enhanced recovery after surgery; Insulin resistance; Preoperative fasting; Evidence quality

Introduction

Surgery induces peripheral insulin resistance, manifesting as enhanced hepatic gluconeogenesis and glycogenolysis with impaired peripheral glucose uptake, and preoperative fasting aggravates it [1,2]. Insulin resistance is associated with increased morbidity, mortality and length of stay [2].

Enhanced recovery programmes are multimodal protocols intended to minimise that stress response, and randomised trials have shown them to reduce length of hospital stay by up to 30 per cent and postoperative complications by as much as 50 per cent [1,3]. They span phases of care and contain numerous components [1].

Preoperative carbohydrate loading is one of those components, and it is the one most readily attributed the programme's success. This review examines what the drink itself has been shown to do.

Objective

This review sets out to establish four things from the published literature. First, what enhanced recovery programmes achieve as a whole against what the carbohydrate component achieves alone. Second, which specific outcomes move and which do not when the drink is tested in isolation. Third, how the strength of guideline recommendation compares with the stated quality of evidence behind it. And fourth, what can be said with confidence, since a weak efficacy signal is not the same as an argument against the practice.

Literature Review

The attribution problem: Enhanced recovery pathways reduce length of stay by up to 30 per cent and postoperative complications by as much as 50 per cent, and contain numerous components across the phases of care (Figure 1) [1,3]. The preoperative anabolic setting of the patient with a carbohydrate drink is described as a major component of the programme [4]. Programme-level effects cannot be attributed to any single element without testing that element separately [1,5].

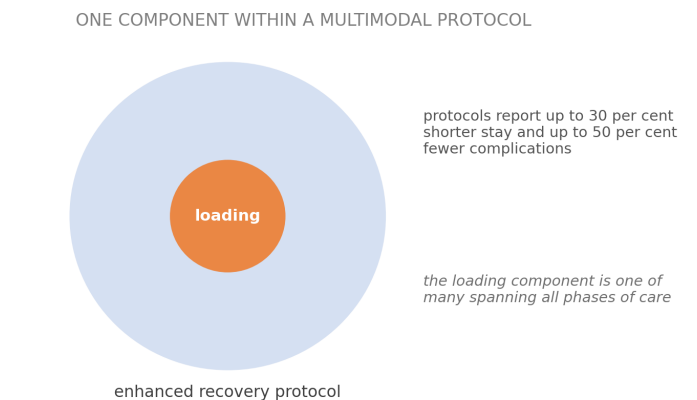


Figure 1: What the programme achieves against one of its components [1,3,4]

What the guidance says and admits: Current enhanced recovery guidelines recommend intake of solid food five to six hours before surgery and clear fluids up to two hours, and strongly recommend preoperative carbohydrate loading (Figure 5) [5,6]. The same source notes that although the recommendation is strong, the quality of the evidence remains low or moderate in the majority of the guidelines (Figure 4) [5]. Gastric emptying of fluid occurs within two to three hours, which is the physiological basis for the two-hour rule [4].

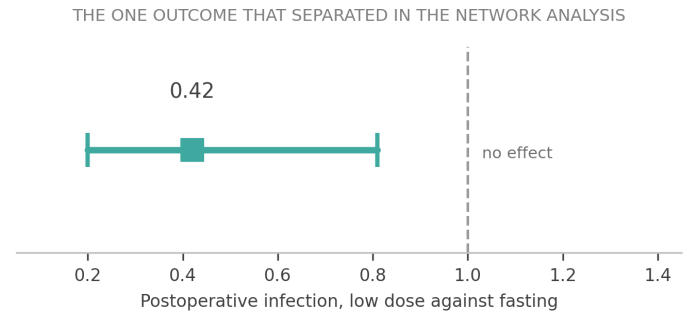


Figure 5: What may be taken before surgery, and when [4,5,6]

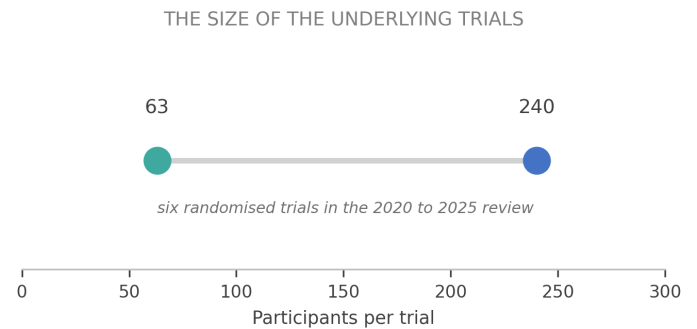


Figure 4: A strong recommendation on weaker evidence [5]

What the pooled evidence reports: A systematic review and meta-analysis searched five databases in October 2021 with an update in November 2024 and identified 44 eligible articles comparing carbohydrate loading with fasting or placebo in elective major non-cardiac surgery under general anaesthesia. Its main outcomes were length of hospital stay, postoperative glucose, postoperative insulin and C-reactive protein, and it reported that loading reduces length of stay relative to fasting [5].

What a network meta-analysis found instead: A Bayesian network meta-analysis of different carbohydrate doses examined postoperative insulin resistance, residual gastric volume, insulin sensitivity, fasting glucose and insulin, C-reactive protein, pain, satisfaction, thirst, hunger, anxiety, nausea and vomiting, fatigue and weakness within the first twenty-four hours, and postoperative infection (Figure 2) [7]. Oral low-dose carbohydrate was associated with postoperative infection compared with fasting at 0.42 (95% CrI 0.20 to 0.81) (Figure 3). In the other outcomes there was no significant difference between the carbohydrate and control groups, and the authors concluded that there is no evidence that preoperative carbohydrate administration alleviates patients' discomfort [7] (Table 1).



Figure 2: Outcomes examined in the network meta-analysis [7]

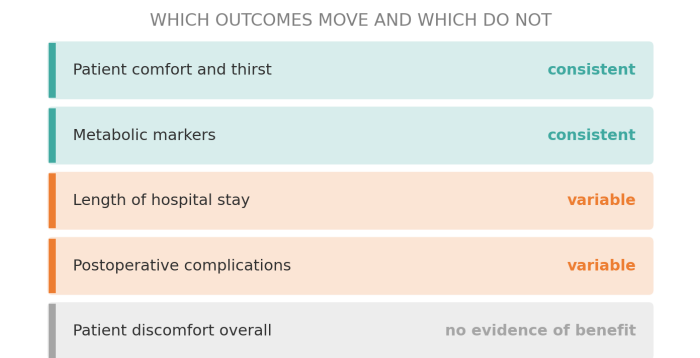


Figure 3: The one outcome that moved clearly [7]

Table 1: Outcomes in a Bayesian network meta-analysis of carbohydrate doses [7]

Outcome	Finding
Postoperative infection	0.42 (95% CrI 0.20 to 0.81) [7]

Table 2: What each synthesis concluded

Insulin resistance	Association reported [7]
Thirst, hunger, anxiety	No significant difference [7]
Pain, satisfaction, nausea	No significant difference [7]
Residual gastric volume	No significant difference [7]

What recent randomised trials show: A systematic review of six randomised trials published between 2020 and 2025, with sample sizes from 63 to 240 in abdominal, colorectal and bariatric surgery, found loading consistently safe with no evidence of delayed gastric emptying or aspiration (Figure 6). It concluded that loading consistently improves comfort and metabolic outcomes while effects on length of stay and complications remain variable, and supported incorporating it as part of multimodal care [8].

COMPONENTS THAT SPAN THE PHASES OF CARE

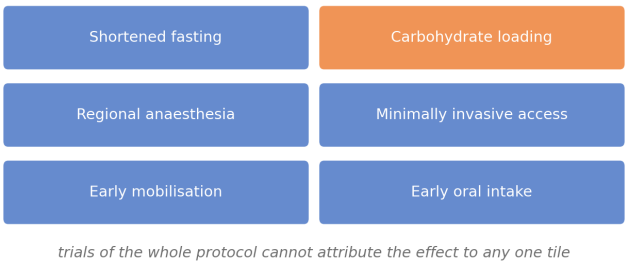


Figure 6: The most consistent finding is safety [8,9,10]

Where the evidence is weakest: A Cochrane review found that preoperative carbohydrate neither increased nor decreased the postoperative complication rate [4,9]. A scoping review of paediatric trials reported that evidence on length of hospital stay and postoperative complications remains inconsistent, indicating a need for further investigation [10] (Table 2).

Source	Conclusion on efficacy
Meta-analysis of 44 articles	Length of stay reduced against fasting [5]
Network meta-analysis	Infection reduced; most outcomes unchanged [7]
Six randomised trials	Comfort and metabolic outcomes improved [8]
Cochrane review	Complication rate unchanged [4,9]
Paediatric scoping review	Inconsistent for stay and complications [10]

In patients with diabetes: Utility in type 2 diabetes is debated because of hyperglycaemia risk, and low-glycaemic-index carbohydrates have been examined as an alternative. A randomised trial gave 60 patients with type 2 diabetes undergoing elective laparoscopic non-gastrointestinal surgery either 300 mL of a solution containing 50 g of isomaltulose or plain water two to three hours preoperatively, with insulin resistance at twenty-four hours assessed by homeostatic model assessment as the primary outcome, alongside gastric ultrasound grading and regurgitation incidence [11].

Extension to other populations: Loading has been examined in a low-resource setting, where it was described as effective and safe in open general surgery [4], and as a feasibility study in older patients undergoing hip fracture surgery, a setting in which the concept is described as new [12]. Reported additional benefits include reduced pain, weakness, nausea and vomiting contributing to earlier rehabilitation [12].

The mechanistic origin of the practice: Preoperative oral carbohydrate was shown to reduce postoperative insulin resistance in the late 1990s [21] and to attenuate it in the immediate postoperative period [22], and its effects on glucose metabolism and gastric contents in moderate surgery were characterised soon after [23]. Preoperative oral carbohydrate therapy has since been reviewed as a distinct topic [13]. The practice displaced a fasting convention whose own evidence base was reviewed and found wanting [19,20].

Earlier syntheses and their range: Meta-analysis of randomised trials in elective surgery was published in 2013 [14] and systematic review of the role of loading in 2014 [15], with network meta-analysis of recovery outcomes following in 2017 [16] and a further network analysis confined to phase II and III trials in abdominal surgery in 2022 [28]. Whether carbohydrate drinks outperform fasting has been asked directly in systematic review [29]. Meta-analysis focused specifically on postoperative discomfort reached its own conclusion on that endpoint [27], which is the outcome on which the syntheses reviewed here most clearly disagree [7,8,27].

What the guidelines and consensus statements specify: Society recommendations for perioperative care in elective colorectal surgery set out the fasting and loading protocol in detail [17], as does practical guidance on clinical nutrition in surgery [18]. A joint consensus statement addresses nutrition screening and therapy within a surgical enhanced recovery pathway [34], and practice guideline recommendations on perioperative fasting have themselves been systematically reviewed [33]. The next phase of enhanced recovery and its remaining challenges have been discussed by the field [6].

Individual trials underlying the syntheses: Randomised trials of preoperative oral carbohydrate have been conducted in abdominal surgery [30,31] and in day-case laparoscopic cholecystectomy [32]. In diabetes specifically, loading has been reported as usable in type 2 diabetes [24] and examined in a prospective feasibility study [25], alongside the enhanced recovery cohort described above [26]. These are the trials from which the pooled estimates derive, and their heterogeneity in dose, comparator and surgical population is the reason those estimates differ [5,7,28] (Table 3).

Table 3: What is and is not established about the carbohydrate component

Question	What the evidence supports
Is it safe?	Yes, most consistent finding [8,9]

Does it reduce infection?	0.42 (0.20 to 0.81) [7]
Does it shorten stay?	Reported, but variable [5,8,10]
Does it improve comfort?	Syntheses disagree [7,8,27]
Is the recommendation strong?	Yes, on low to moderate evidence [5]

Method

Search strategy: PubMed and the archives of the major surgical, anaesthetic and clinical nutrition journals were searched for studies of preoperative carbohydrate loading. Search terms combined preoperative carbohydrate loading with enhanced recovery, insulin resistance, length of stay, fasting and network meta-analysis. Reference lists of the pooled meta-analysis [5] and the network meta-analysis [7] were screened by hand for primary sources.

Eligibility: Syntheses and randomised trials were included if they compared preoperative carbohydrate loading against fasting or placebo and reported clinical, metabolic or patient-reported outcomes. Guideline documents are cited for their recommendations and their stated evidence quality, and identified as such.

Data extraction and handling: Population, comparator, carbohydrate dose where reported and the outcome as published were extracted. Whether an effect was measured for the whole enhanced recovery programme or for the carbohydrate component alone is stated in every case, because programme-level reductions in stay and complications are frequently quoted in support of the component and the two are not the same claim. This review reports published findings and does not constitute guidance on preoperative fasting, carbohydrate administration or perioperative management for any patient, all of which are matters for the treating anaesthetic and surgical team. No pooling or re-analysis was performed. Figures 1 to 6 and Tables 1 to 3 reproduce published values only. This is a narrative synthesis of published literature and was not registered as a systematic review.

Concluding Remarks

The question in the title has a specific answer and it is narrower than the practice's reputation. Enhanced recovery programmes reduce length of stay by up to 30 per cent and complications by as much as 50, but they comprise many components across the whole episode of care [1,3]. Those figures are routinely cited in discussions of the carbohydrate drink, and they are not evidence about the drink.

Tested on its own, the drink produces one clear signal. In the network meta-analysis, low-dose oral carbohydrate was associated with reduced postoperative infection at 0.42 with a credible interval from 0.20 to 0.81, an interval comfortably excluding no effect [7]. That is a real finding and it is the most

useful thing in this literature.

The same analysis found no significant difference in most of what it examined, including thirst, hunger, anxiety, pain, satisfaction, nausea, vomiting, fatigue and weakness, and concluded specifically that there is no evidence the drink alleviates patient discomfort [7]. Comfort is among the benefits most often claimed for it, and a review of six randomised trials does report improved comfort [8]. Those two conclusions sit in tension, and neither can be dismissed.

On evidence quality, the guidelines are more candid than their critics sometimes acknowledge. They recommend loading strongly and state that the quality of the underlying evidence remains low or moderate [5]. A strong recommendation on moderate evidence is a defensible position when an intervention is cheap, safe and physiologically plausible, and it should be read as that rather than as an overstatement of the data.

Safety is where the literature is most consistent, and it carries more weight than it usually receives. Six randomised trials found no delayed gastric emptying and no aspiration, a Cochrane review found the complication rate unchanged, and gastric emptying of fluid within two to three hours provides the mechanistic basis [4,8,9]. The practice replaced prolonged fasting, which itself aggravates the metabolic response to surgery, so the relevant comparison is not against nothing [1,4].

That reframes the practical question. If the drink is safe, inexpensive, replaces a harmful default, and reduces postoperative infection, the case for it does not depend on resolving whether it shortens stay or improves comfort [4,7,8]. Overstating the length of stay benefit is what leaves the practice vulnerable when a synthesis fails to reproduce it [7,10].

Three limitations belong with these conclusions. The syntheses differ in comparator, with some using fasting and some placebo, and in carbohydrate dose, which the network analysis found to matter [5,7]. Length of stay is determined by discharge criteria and local practice as much as by physiology, which makes it a noisy endpoint for a single preoperative intervention [5,8]. And most trials enrol elective major abdominal, colorectal or bariatric surgery in adults, so findings transfer poorly to paediatric, emergency and hip fracture populations where the evidence is described as new or inconsistent [10,12].

A design point follows from the attribution problem and it is not hypothetical. Trials comparing loading against fasting within an otherwise identical pathway are the ones that isolate the component, and the syntheses reviewed here are built from exactly those [6,7,8]. What they cannot do is tell a service already running a full protocol how much of its result depends on the drink, because that question requires removing one element from a working pathway and few would design such a trial [4,19].

The comparator distinction deserves more attention than it usually receives. Loading against fasting and loading against a placebo drink are different experiments: the first tests carbohydrate plus fluid plus a shortened fast, the second tests carbohydrate alone [6,7]. Where a synthesis pools both, part of any observed benefit may belong to the fluid or to the shorter fast rather than to the carbohydrate, and shortened fasting is itself a separate recommendation [5,21].

Finally, a note on why this matters beyond the academic point. The intervention is cheap, safe and easy to deliver, so the cost of continuing it if the specific benefits prove smaller than claimed is low [8]. The cost of overstating it is that attention and audit effort move toward the visible component and away from the parts of the pathway carrying more of the effect, which the protocol-level trials cannot identify either [4,19].

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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