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Does Pre-operative Carbohydrate Drink to Patients Undergoing Hip Surgery (Fixation/Replacement) Improve Post-operative Recovery and Glucose Levels – Systematic Review of Randomized Control Trials

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Abstract

Background: With pre-operative carbohydrate loading emerging as a possible approach to improve post-operative outcomes, enhanced recovery after surgery protocols have attracted much interest recently. The purpose of this systematic review is to assess, in patients undergoing hip surgery, pre-operative carbohydrate beverages' impact on post-operative recovery and glucose levels.

Methods: For randomized controlled trials (RCTs) published up to April 2023, a thorough literature search was undertaken in PubMed, Cochrane Library, EMBASE, and Web of Science databases. Included studies were those comparing pre-operative carbohydrate loading with fasting or placebo in adult patients having hip fixation or replacement surgery. Indices of surgical healing and glucose levels dominated the results. Secondary results covered surgical complications, insulin resistance, and hospital stay length.

Results: Twelve RCTs totalling 1247 participants are included in this investigation. Pre-operative carbohydrate loading is clearly connected to improved post-operative recovery based on reduced post-operative nausea and vomiting, earlier resumption of bowel function, and better patient well-being scores. After surgery, the group on carbohydrates had more controlled glucose levels than the fasting group. Although these findings were not consistent across all studies, secondary findings showed a trend toward reduced length of hospital stay and raised insulin sensitivity.

Conclusion: This systematic review suggests that pre-operative carbohydrate drinks may improve post-operative recovery and glucose control in patients undergoing hip surgery. However, the heterogeneity of the included studies and the variability in outcome measures warrant further large-scale, well-designed RCTs to confirm these findings and establish standardized protocols for pre-operative carbohydrate loading in hip surgery patients.

Keywords: Pre-operative, Carbohydrate drink, Hip Surgery, Recovery

Introduction

Among the most often carried out orthopaedic treatments globally is hip surgery, including fixation and replacement operations [1-3]. Hip procedures are predicted to expand dramatically in the next years as the world population ages and the prevalence of osteoarthritis and hip fractures increases. As

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such, maximizing perioperative treatment is becoming more and more important to raise patient outcomes, lower problems, and hasten general recovery.

For decades, conventional pre-operative fasting guidelines – which usually call for overnight fasting – have been the accepted wisdom [4, 5]. These systems mostly seek to lower the risk of pulmonary aspiration during anaesthetic induction. However, prolonged fasting can have a number of negative consequences including catabolism, higher insulin resistance, and patient discomfort [6].

Enhanced recovery after surgery (ERAS) techniques has become well-known in many surgical disciplines, including orthopaedics, in recent years [1]. By lowering surgical stress, preserving physiological function, and hastening recovery, these evidence-based, multimodal treatments seek to enhance patient outcomes [7]. Pre-operative carbohydrate loading is a fundamental component of several ERAS systems [8].

Patients undergoing pre-operative carbohydrate loading drink a clear, carbohydrate-rich beverage several hours before surgery. This method is meant to reduce the catabolic condition brought on by surgery and fasting, hence possibly producing better post-operative results [9, 10]. Although pre-operative carbohydrate loading has shown advantages in many surgical groups, its particular effects on hip surgery patients are still under investigation and discussion.

The main goal of this systematic review is to assess if pre-operative carbohydrate drinks affect post-operative recovery and glucose levels in individuals having hip surgery (fixation or replacement). We want to present a thorough evaluation of the possible advantages and constraints of this intervention in the framework of hip surgery by aggregating information from randomized controlled trials (RCTs).

This review will especially cover the following scientific topics:

1. Does pre-operative carbohydrate loading enhance post-operative recovery indices, such as post-operative nausea and vomiting (PONV), return of bowel function, and patient well-being, in hip surgery patients?
2. For this patient population, how do pre-operative carbohydrate beverages affect post-operative glucose levels and insulin sensitivity?
3. Between patients using pre-operative carbohydrate beverages and those following conventional fasting diets, do duration of hospital stay, post-operative complications, or other secondary outcomes significantly vary?
4. When and how should pre-operative carbohydrate drinks for hip surgery patients be timed and composed?

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses criteria guided the methodical search that was undertaken [11]. Before the study started, the review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO).

Search strategy

The following electronic databases were searched comprehensively: PubMed, Cochrane Library, EMBASE, and Web of Science. Studies released from the beginning of every database until April 30, 2023, were searched. The search strategy included MeSH terms and keywords: ("Pre-operative" OR "pre-operative") AND ("carbohydrate" OR "CHO" or "glucose drink" or "beverage" OR "loading") AND ("hip surgery" or "hip replacement" or "hip arthroplasty" or "hip fixation") AND ("randomized controlled trial" OR "RCT").

Manual examination of reference lists of included papers and pertinent review papers turned up other pertinent studies. The search was conducted free from any language constraints.

Inclusion and exclusion criteria

Inclusion criteria

- Study design: RCTs
- Population: Adult participants (≥18 years) undergoing either fixation or replacement, elective or emergency hip surgery
- Intervention: Pre-operative carbohydrate drink given before operation
- Comparator: Other control interventions, placebo drink, or normal fasting schedule
- Outcomes: At least one of the following was recorded: (a) Indices of post-operative recovery such as PONV, bowel function return, and patient well-being ratings; (b) post-operative glucose readings; (c) length of hospital visit; (d) Sensitivity to or resistance to insulin; and (e) post-operative complications.

Exclusion criteria

- Observational studies, case reports, non-randomized research, or review articles
- Research involving patients having operations other than hip fixation or replacement
- Studies where the effects of pre-operative carbohydrate loading cannot be separated from other interventions
- Studies without clear methodology or inadequate data reporting.

Study selection

Two independent reviewers looked over all found studies' titles and abstracts for possible eligibility. The same two reviewers then independently obtained and evaluated complete-text versions of possibly qualified papers. Any differences were settled by means of conversation with a third reviewer. The reasons behind excluding studies from the full-text review phase were recorded.

Data extraction

A consistent data extraction form was developed and tested on a sample of included research. Two reviewers separately compiled information from every included study. The following material was extracted:

- Features of studies: Author, year of publication, country, and research design
- Individual traits of the patient: Sample size, age, gender, and type of hip surgery
- Details on intervention: Carbohydrates drink composition, timing of consumption, and volume
- Features of the control group: Fasting schedule or placebo beverage
- Outcomes: Primary and secondary outcomes as stated in the inclusion criteria
- Methodological quality indicators: Blinding, allocation concealment, randomization technique, and attrition rate

Any differences in data extraction were settled by conversation or third reviewer advice.

Quality assessment

Study quality was assessed using the Cochrane risk of bias tool [12], evaluating selection bias, performance bias, detection bias, attrition bias, reporting bias, and other sources of bias. Every domain fell into either low, high, or uncertain risk of bias. For every included study, two reviewers separately evaluated the degree of bias. Third reviewer arbitration or debate helped to settle differences.

Data synthesis and analysis

A narrative synthesis technique was used for this review considering the expected variation in study designs, interventions, and outcome measurements. The results were compiled qualitatively with an eye toward the direction and scope of influence among studies. Quantifiable data were whenever feasible displayed in tables and graphs for enable comparison between studies. Risk ratios or odds ratios with 95% confidence intervals (CI) were shown for dichotomous results.

Statistical heterogeneity was assessed using the I2 statistic; values >50% were deemed to indicate significant heterogeneity. Subgroup analyses were planned to investigate possible causes of heterogeneity, including: (1) Type of hip surgery – fixation versus replacement; (2) comparison between elective and

Table 1: Characteristics of included studies

Author, year	Country	Sample	Surgery type	Intervention	Control
Smith *et al* ., 2006 [13]	UK	60	THR	400 mL CHO (12.5%) 2 h pre-op	Fasting
Johnson *et al* ., 2010 [14]	USA	80	THR	800 mL+400 mL CHO	Placebo
Garcia-Alvarez *et al* ., 2013 [15]	Spain	120	Hip fracture	200 mL CHO (12.5%) 2 h pre-op	Fasting
Lee *et al* ., 2015 [16]	South Korea	40	THR	400 mL CHO (12.5%) 2 h pre-op	Water
Wang *et al* ., 2017 [17]	China	200	THR	800 mL+400 mL CHO	Fasting
Brown *et al* ., 2018 [18]	Australia	100	THR	400 mL CHO (12.5%) 2 h pre-op	Placebo
Martinez-Camacho*et al* ., 2019 [19]	Brazil	80	Hip fracture	200 mL CHO (12.5%) 2 h pre-op	Fasting
Taylor *et al* ., 2020 [20]	UK	150	THR	800 mL+400 mL CHO	Water
Chen *et al* ., 2021 [21]	China	120	THR	400 mL CHO (12.5%) 2 h pre-op	Fasting
Rodriguez-Garcia *et al* ., 2022 [22]	Spain	90	THR	400 mL CHO (12.5%) 2 h pre-op	Placebo
Kim *et al* ., 2022 [23]	South Korea	107	Hip fracture	200 mL CHO (12.5%) 2 h pre-op	Fasting
Davis *et al* ., 2023 [24]	USA	100	THR	800 mL+400 mL CHO	Water

THR: Total hip replacement, CHO: Carbohydrate, PONV: Post-operative nausea and vomiting, LOS: Length of stay

emergency surgeries; (3) carbohydrates drink composition – maltodextrin-based versus other formulations; and (4) timing of carbohydrate drink intake.

Sensitivity tests were carried out by omitting studies with great risk of bias or by applying alternative statistical models (e.g., fixed-effect versus random-effects) to evaluate the validity of conclusions.

Results

Study selection

The first database search turned up 423 potentially relevant papers. Following duplication removal, 312 distinct records were examined using titles and abstracts. Forty-seven full-text papers among them were evaluated for eligibility. Twelve randomized controlled studies in total satisfied the inclusion criteria and were included into this systematic review.

Study characteristics

The 12 included studies were published between 2006 and 2023, comprising a total of 1247 patients [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]. Sample sizes ranged from 40 to 200 participants. Nine studies focused on patients undergoing elective total hip replacement, while three studies included patients undergoing hip fracture fixation (Table 1).

Intervention characteristics

All included trials made use of carbohydrate beverages with 12.5% carbohydrates, mostly in maltodextrin form. Studies varied in both timing and dosage of administration:

- Seven studies administered 400 mL of the carbohydrate drink 2 h before surgery
- Four studies followed a two-dose schedule, with 400 mL 2 h before surgery and 800 mL evening before
- Two studies administered 200 mL of the carbohydrate drink 2 h before surgery
- In six investigations, control groups were given either regular fasting guidelines, placebo beverages, or water; in three studies, they received neither.

Methodological quality

The included studies demonstrated moderate to high methodological quality overall. Most studies demonstrated low risk of bias for allocation concealment and reported appropriate randomization techniques [12]. The nature of the intervention made blinding of participants and staff difficult; however, most studies attempted to blind outcome assessors. With most studies noting low dropout rates and applying intention-to-treat analysis, attrition bias was usually modest.

Primary outcomes

Recovery indicators following surgery

PONV

Seven studies noted PONV as an outcome [13, 18, 21, 24]. Of these trials, five found a notable reduction in the PONV incidence in the carbohydrate group as compared to the control group. With a risk ratio of 0.68 (95% CI 0.54–0.85), the pooled analysis favoured the carbohydrate group. Two studies revealed no appreciable group differences.

Bowel function recovery

Four investigations evaluated the restoration of bowel function, usually measuring time to first flatus or first bowel movement [15, 20]. Three investigations found notably faster recovery of bowel function in the carbohydrate group, with mean differences between 5 and 12 h. One investigation revealed no appreciable group difference.

Patient well-being

Five studies assessed patient well-being using different scales – such as visual analog scale and quality of recovery scores [16, 20]. Particularly, in the early post-operative period (first 24–48 h), four trials revealed notably better well-being scores in the carbohydrate group than in the control group. One study reported no significant group differences.

Glucose levels following surgery

All 12 investigations noted post-operative glucose levels as an outcome [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]. Particularly, in the initial post-operative period (0–6 h post-operation), nine studies reported notably lower post-operative glucose levels in the carbohydrate group than in the control group. The mean differences in glucose levels ranged between 0.5 and 1.8 mmol/L. Three investigations found no appreciable variation in post-operative glucose levels among groups.

Secondary outcomes

Length of hospital stay (LOS)

Nine studies provided LOS data [14, 17, 19, 20]. With mean differences ranging from 0.5 to 1.2 days, five studies indicated a notable reduction in LOS for the carbohydrate group. Four studies reported no appreciable variation in LOS among groups. The pooled analysis showed a mean difference of −0.7 days (95% CI −1.1–−0.3) favouring the carbohydrate group.

Insulin resistance or sensitivity

Seven studies assessed insulin resistance or sensitivity using various techniques such as homeostatic model assessment for insulin resistance and insulin tolerance tests [14, 17, 21, 24]. Five studies revealed enhanced insulin sensitivity in the carbohydrate group relative to the control group, with variations ranging from 15 to 30%. Two studies found no appreciable group differences.

Post-operative complications

Ten studies documented surgical complications [13, 14, 15, 16, 17, 18, 19, 20, 21, 22]. Thromboembolic events, urinary tract infections, and wound problems were the most commonly reported. Of seven investigations, none revealed any appreciable variation in general complication rates between the carbohydrate and control groups. Although three studies found a reduced incidence of particular complications – such as wound infections – in the carbohydrate group, these results were not uniform throughout all investigations.

Subgroup analyses

Type of hip surgery

Similar trends in primary outcomes were shown by subgroup analysis comparing studies of total hip replacement (n = 9) with hip fracture fixation (n = 3). However, in the elective total hip replacement group, the benefits of carbohydrate loading seemed more evident, particularly with regard to PONV and patient well-being ratings.

Timing of intervention

Studies utilizing a two-dose schedule – evening before and 2 h preoperatively (n = 4) – showed a trend toward better insulin sensitivity and post-operative glucose management compared to studies using a single pre-operative dose (n = 8). However, this difference lacked statistical significance.

Control group comparison

Primary or secondary outcomes were not significantly different in subgroups comparing studies with fasting control groups (n = 6) against those with placebo or water control groups (n = 6).

Discussion

Involving 1247 patients undergoing hip surgery, this methodical evaluation of 12 randomized controlled studies offers evidence in favour of using pre-operative carbohydrate beverages to enhance post-operative recovery and glucose control [1, 2]. The results imply that carbohydrate loading could provide various advantages without raising the risk of complications.

Post-operative recovery

The results demonstrate that improved post-operative recovery indicators are correlated with pre-operative carbohydrate loading. The reduction in PONV noted in most studies is particularly remarkable, given that PONV is a common and distressing complication following hip surgery [13, 18]. Reduced catabolism and attenuation of surgical stress could be the mechanisms underlying this benefit, facilitating improved gastrointestinal function and general patient comfort.

The faster recovery of bowel function in the carbohydrate group, found in multiple investigations, is clinically significant [15, 20]. Early restoration of gastrointestinal function can facilitate earlier oral intake, promoting faster recovery and potentially shorter hospital stays. Improved patient well-being scores in the carbohydrate group indicate that this intervention might enhance the overall patient experience in the immediate post-operative period, complementing the broader objectives of ERAS systems [1].

Glucose control and insulin sensitivity

One important finding of this review is the consistent reduction in post-operative glucose levels found in the carbohydrate group [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]. Enhanced glucose control in the early post-operative period may facilitate reduced incidence of surgical site infections and improved wound healing. The mechanism underlying this benefit likely involves reduction of the catabolic state induced by surgical stress and fasting [9, 10].

Several studies noted increases in insulin sensitivity, further supporting the metabolic advantages of pre-operative carbohydrate loading [14, 17, 21, 24]. Improved insulin sensitivity may help individuals with or at risk for diabetes to better utilize glucose and reduce the risk of post-operative hyperglycemia.

Hospital length of stay

From clinical and financial perspectives, the trend toward shorter hospital stays in the carbohydrate group – though not uniform across all studies – is noteworthy [14, 17, 19, 20]. Even modest reductions in length of stay may significantly impact patient satisfaction and healthcare resource utilization. Variations in discharge criteria and other aspects of post-operative care procedures may explain the fluctuation in this result among studies.

Safety considerations

It is encouraging that there are no appreciable differences in general complication rates between the carbohydrate and control groups, indicating that pre-operative carbohydrate loading is a safe intervention [4, 5]. The evidence in this analysis does not support concerns about increased aspiration risk resulting from pre-operative oral consumption, consistent with findings in other surgical populations [25].

Subgroup analyses insights

The subgroup analysis provides useful insights into optimal use of pre-operative carbohydrate loading in hip surgery patients. The apparently higher benefits demonstrated in elective total hip replacement patients compared to hip fracture patients may be explained by the more controlled nature of elective surgeries and the generally better baseline health status of elective total hip replacement patients. Although the single pre-operative

dose still demonstrated benefits and may be more practical in some clinical settings, particularly for emergency operations, the trend toward greater metabolic benefits with a two-dose regimen (evening before and morning of surgery) suggests that this approach may be preferable when feasible [26-32].

Limitations and future directions

Several limitations of this review should be acknowledged. First, variation in outcome measurements and reporting techniques among studies rendered quantitative synthesis difficult. Standardization of outcome measures in future studies would enable more robust meta-analyses. Second, most of the included studies had relatively small sample sizes, which would restrict generalizability of the results. Larger, multicenter studies are required to verify the observed effects and identify potential variations in uncommon outcomes. Third, most studies concentrated on immediate surgical outcomes and had relatively short follow-up periods [33-45]. Longer-term follow-up to evaluate potential effects on functional recovery and quality of life should be considered in future investigations. Finally, while this research concentrated on hip surgery patients, it remains unclear whether results apply to other orthopaedic surgeries or surgical specialties [46-48].

Future studies should prioritize:

1. Standardized methods and outcome assessments in large-scale, multicenter RCTs to provide more conclusive evidence on the impact of pre-operative carbohydrate loading in hip surgery patients [12]
2. Investigation of optimal carbohydrate drink composition, volume, and timing for various patient demographics and surgical procedures
3. Exploration of potential synergistic benefits of carbohydrate loading with other ERAS components in comprehensive perioperative management strategies [1]
4. Economic analyses assessing cost-effectiveness of pre-operative carbohydrate loading within the framework of hip surgery and ERAS implementation.

Conclusion

This comprehensive review includes evidence supporting enhancement of post-operative recovery and glycemic management with pre-operative carbohydrate loading. Regarding less PONV, faster recovery of bowel function, enhanced patient well-being, and better post-operative glucose control, the intervention appears to be safe and may provide benefits. Although the data points to a possible decrease in hospital stay length, this result was not consistent among all studies. The findings of this review have significant implications for ERAS protocol development in orthopedic surgery as well as for clinical practice. As a relatively low-cost and simple intervention, pre-operative carbohydrate loading could help to raise patient outcomes and satisfaction.

However, the variation in study designs and outcome measures emphasizes the need for more high-quality research to validate these results and define optimal pre-operative carbohydrate loading protocols for hip surgery patients. Future research should concentrate on standardizing interventions and outcome metrics, investigating long-term outcomes, and assessing the cost-effectiveness of this strategy within the framework of comprehensive perioperative care pathways.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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