International Surgery Journal
Marcuccilli J et al. Int Surg J. 2025 Oct;12(10):1753-1758
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20252916

Systematic Review

Preoperative carbohydrate loading vs fasting: effects on postoperative recovery and outcomes in surgery

Joseph Marcuccilli*, Nathan Jatczak

A.T. Still University, Medicine, Kirksville Missouri, MO, USA

Received: 22 August 2025
Revised: 04 September 2025
Accepted: 06 September 2025

***Correspondence:**
Dr. Joseph Marcuccilli,
E-mail: JMarcuccilli@atsu.edu

ABSTRACT

Traditional preoperative fasting reduces aspiration risk but contributes to catabolism, insulin resistance and patient discomfort. Enhanced recovery after surgery (ERAS) protocols increasingly endorses preoperative carbohydrate loading (PCL) as an alternative. This systematic review, conducted according to PRISMA guidelines, evaluated randomized controlled trials (RCTs) published between 2020–2025 comparing PCL versus standard fasting in adult general surgery populations. Eligible studies included abdominal, colorectal and bariatric procedures. Data extraction covered trial design, carbohydrate regimens, recovery endpoints (time to gastrointestinal function, oral intake, ambulation, hospital stay), metabolic markers, complications and patient-reported outcomes. Six RCTs (sample sizes 63–240) met criteria. PCL was consistently safe, with no evidence of delayed gastric emptying or aspiration. Across trials, PCL improved patient comfort (reductions in hunger, thirst, fatigue, anxiety), attenuated insulin resistance and dampened inflammatory stress responses. Several studies demonstrated earlier gastrointestinal recovery and reduced hospital stay, though findings were inconsistent. Complication rates were lower in some cohorts, particularly colorectal surgery, but unchanged in others. In diabetic patients, PCL with individualized insulin protocols was safe and improved perioperative comfort, though bowel recovery was unaffected. Integration of PCL with other ERAS components, such as goal-directed fluid therapy, appeared to amplify benefits. In summary, PCL is a safe, well-tolerated alternative to prolonged fasting in general surgery. It consistently improves comfort and metabolic outcomes, while effects on length of stay and complications remain variable. Evidence supports incorporating PCL as part of multimodal ERAS pathways, with further research warranted in high-risk subgroups such as elderly and diabetic patients.

Keywords: Carbohydrate loading, Enhanced recovery after surgery, Insulin resistance, Postoperative recovery, Preoperative fasting

INTRODUCTION

Prolonged preoperative fasting has traditionally been used to reduce the risk of pulmonary aspiration during anesthesia induction.[1] However, fasting can increase patient discomfort, worsen metabolic stress and contribute to postoperative insulin resistance.[2,4] ERAS protocols now recommend allowing clear carbohydrate-rich fluids up to two hours before anesthesia to mitigate catabolism and discomfort, potentially improving recovery.[5,7] Several earlier systematic reviews and meta-analyses demonstrated that preoperative carbohydrate drinks are safe, reduce insulin resistance and improve patient comfort.[8,12] Yet, uncertainty remains regarding their effects on clinical endpoints such as bowel recovery, hospital length of stay (LOS) and postoperative complications. Moreover, recent trials in diabetic and elderly populations warrant updated synthesis. This systematic review therefore evaluated blinded RCTs published from 2020–2025 that compared PCL with standard fasting in adult general surgery populations. We aimed to clarify the consistency of evidence regarding

patient comfort, metabolic outcomes, gastrointestinal recovery, complications and LOS, while identifying knowledge gaps and future research directions.

METHODS

This review followed PRISMA guidelines for systematic reviews. PubMed and PMC databases were searched for RCTs published between January 2020 and March 2025 using the terms: "preoperative carbohydrate," "carbohydrate loading," "surgery," "randomized controlled trial," and "fasting."

Inclusion criteria

It includes peer-reviewed blinded RCTs comparing oral PCL versus fasting or placebo in adult general surgery (including abdominal, colorectal and bariatric surgery). Relevant trials were identified via keywords (e.g., "preoperative carbohydrate randomized controlled trial", surgical outcomes, fasting) and cross-references from systematic reviews.

Exclusion criteria

non-randomized studies, pediatric populations, non-general surgery (e.g., orthopedic, cardiac), reviews or meta-analyses, non-blinded designs, trials without PCL as intervention and articles not available in English.

For each trial, we extracted methodology (population, surgery type, carbohydrate regimen vs control) and results (recovery endpoints, metabolic markers, complications), two reviewers independently extracted study characteristics, interventions, outcomes (GI recovery, metabolic markers, complications, patient comfort) and safety findings. A comparative synthesis identified common conclusions and conflicts across studies.

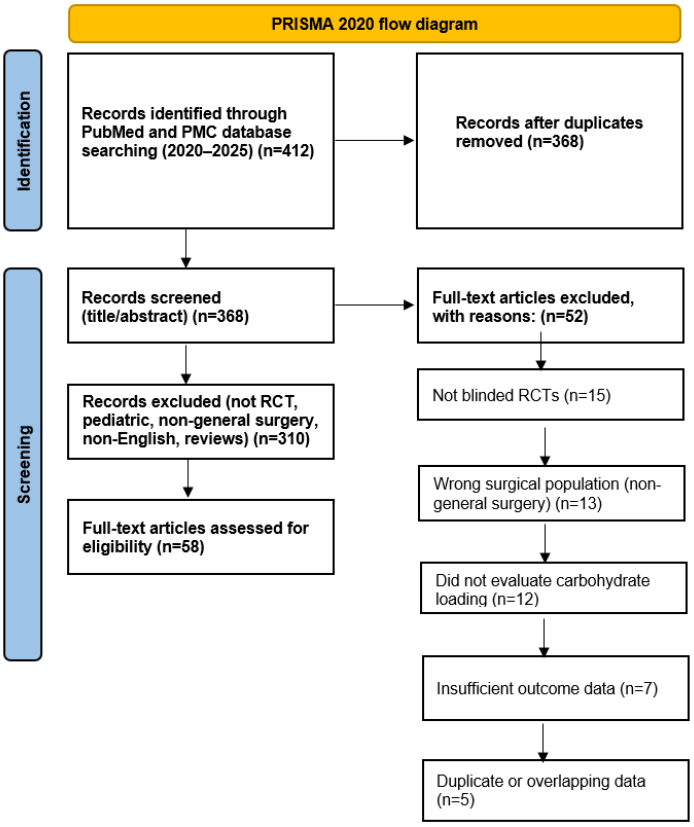

Figure 1: PRISMA 2020 flow diagram.

A PRISMA flowchart of the screening process is shown in Figure 1.

RESULTS

Suh et al (bariatric surgery)

Single-center RCT (n=134) in minimally invasive Roux-en-Y gastric bypass or sleeve gastrectomy patients.[1]

Intervention: Two 400 ml carbohydrate drinks (evening before and 3 h pre-op).

Control: NPO after midnight. Primary outcomes were postoperative nausea/vomiting (PONV), LOS and complications. Results showed no significant differences in LOS or overall complications. No aspiration occurred in the PCL group. Among RYGB patients, PCL shortened the duration of nausea. Glycemic control (even in diabetic patients) was similar between groups.

Conclusion: Pre-op CHO drinks are safe and can reduce PONV duration, but had no detectable effect on LOS or major outcomes.

Liu et al and Fan et al (open GI surgery, elderly)

Prospective RCT (n=120, age ≥65) undergoing open gastrointestinal surgery.[2] All patients had standard anesthesia.

Intervention: 200 ml CHO drink 2 h pre-op+goal-directed intraoperative fluid therapy (guided by advanced monitors).

Control: Fasting+liberal IV fluids. Compared intra/postoperative fluids, time to flatus and oral intake, complications and LOS. The CHO+GDFT group used significantly less intra-op crystalloids and had shorter time to first flatus (56±14 h vs 64±22 h, p=0.002) and oral intake (72±17 h vs 85±27 h, p=0.011). Postoperative complication rate was lower in the CHO + GDFT group (25% vs 48%, p=0.013).

Conclusion: Combined perioperative optimizations (CHO and GDFT) improved GI recovery and reduced complications (Note: The study changed two variables, so CHO's isolated effect is confounded by fluid strategy).

Li et al (diabetic GI surgery)

Single-center RCT (n=63) of type-2 diabetic patients undergoing elective GI surgery.[3]

Intervention: 50 g dextrose and individualized insulin dosing 2 h pre-op.

Control: Standard overnight fasting.

Primary outcome: Time to first flatus.

Secondary: Patient comfort scores (thirst, hunger, fatigue by VAS) and PONV. Time to flatus was not different (median 41 h vs 43 h; HR 1.24, p=0.411). However, the PCL group reported significantly lower scores for preoperative thirst, hunger and fatigue and postoperative thirst and hunger (all p<0.01). They also had less intraoperative hypotension (16% vs 41%, p=0.031) and less PONV in 24 h (9.7% vs 31.3%, p=0.034).

Conclusion: In diabetic patients, PCL (with insulin) did not hasten GI recovery but improved perioperative comfort and reduced PONV and hypotension.

Vishak et al (general elective surgery)

Prospective RCT (n=240, age 40–65, mixed surgeries under regional anesthesia).[4] Patients stratified by diabetes.

Intervention: 400 ml drink with 50 g dextrose 2 h pre-op.

Control: 400 ml plain water.

Outcomes: Gastric volume (ultrasound), blood glucose, thirst/discomfort. Gastric volume was similar between CHO and water groups for both diabetic and non-diabetic patients, confirming safety. As expected, diabetic subjects receiving CHO had a transient blood glucose rise (183 vs 139 mg/dl after 2 h) that normalized by 6 h (managed with insulin). Importantly, the CHO groups (both diabetic and non) reported significantly less preoperative thirst and discomfort than fasting groups.

Conclusion: Pre-op CHO is safe (no delayed gastric emptying) and markedly improves patient comfort, even in diabetics, without adverse glycemic or safety issues.

***Rizvanović et al (open colorectal cancer surgery*)**

RCT (n=60) for open colorectal resection.[5]

Intervention: CHO solution night before and 2 h pre-op; Control: NPO after midnight.

Primary outcomes: Neutrophil/lymphocyte ratio (NLR) and postoperative complications (Clavien–Dindo up to 30 days). Postoperative NLR and ΔNLR were significantly lower in the CHO group (p<0.001). The control group had six major complications (five grade IV, one grade V), whereas the CHO group had none.

Conclusion: Pre-op CHO loading substantially dampened inflammatory response (lower NLR) and was associated with fewer and less severe complications.

Kumar et al (elective colorectal surgery)

Open-label RCT (n=72) in elective colorectal procedures.[6]

Intervention: Standard ERAS CHO drink 2 h pre-op.

Control: Fasting. Measured insulin resistance (IR), IL-6, clinical well-being, intestinal recovery, ambulation, morbidity and LOS.

Results: The CHO group had significantly reduced postoperative IR on day-of-surgery and POD1/3 (p=0.0336) and markedly lower inflammatory markers and GPS (p<0.001). They also reported less thirst, hunger and dry mouth and had a shorter hospital stay.

Conclusion: PCL in colorectal surgery significantly reduced metabolic stress and improved multiple clinical outcomes, including shortened LOS and better patient comfort.

Summary of randomized controlled trials evaluating the effects of preoperative carbohydrate loading (PCL). This table presents key design elements, interventions, outcomes and conclusions across six recent RCTs

investigating PCL. Common findings include improved patient comfort and reduced postoperative nausea and metabolic stress, while effects on length of stay and complications vary by study design and patient population (Table 1).

Commonalities (top 5)

Safety: PCL did not increase gastric volume or aspiration risk.

Patient comfort: Consistent reductions in preop discomfort (hunger, thirst, anxiety).

Metabolic effects: Lower postoperative insulin resistance/inflammation.

Early GI recovery: Several studies noted earlier return of GI function.

Enhanced ERAS integration: PCL aligns as a key ERAS component.

Divergences (top 5)

Length of stay: Mixed results shorter in some vs. no change in others.

Complications: Reduced in some vs. unchanged in others.

Diabetics: Variable insulin protocols and outcomes.

Study designs: Differences in CHO dosing, adjunctive therapies (e.g., GDFT confounder).

Endpoints: Focus ranged from metabolic markers to patient-reported outcomes.

Table 1: Randomized controlled trials of preoperative carbohydrate loading in general surgery.

Author, year	Population and surgery	Intervention	Control	Main outcomes	Key findings
Suh et al, 2021[36]	Bariatric surgery (n=134)	400 ml CHO night before+3 h pre-op	NPO after midnight	PONV, LOS, complications	Reduced nausea; safe in diabetics; no LOS/complication difference
Liu et al, 2021[37]	Elderly open GI surgery (n=120)	200 ml CHO+goal-directed fluids	Fasting+liberal fluids	GI recovery, fluids, LOS, complications	Faster flatus/oral intake, fewer complications
Li et al, 2022[38]	Diabetic GI surgery (n=63)	50 g dextrose+insulin protocol	Fasting	GI recovery, comfort, PONV	No GI difference; improved comfort; reduced hypotension & PONV
Vishak et al, 2023[39]	Mixed elective (n=240)	400 ml 50 g dextrose	Water	Gastric volume, glycemia, comfort	No gastric delay; safe in diabetics; improved comfort
Rizvanović et al, 2023[40]	Colorectal cancer (n=60)	CHO night before+2 h pre-op	NPO after midnight	NLR, complications	Lower NLR, zero severe complications in PCL
Kumar et al, 2024[41]	Elective colorectal (n=72)	CHO 2 h pre-op	Fasting	IR, IL-6, LOS, comfort	Reduced, IR/inflammation; shorter LOS; improved comfort

Trends toward consensus

Safety of PCL, metabolic benefits, improved patient-centered outcomes.

Trends away from consensus

Consistent LOS reduction, universal complication reduction, clear long-term glycemic benefits.

Emerging insights

Subgroup (elderly/diabetic) benefits, PCL's role in holistic ERAS bundles.

DISCUSSION

This review highlights consistent evidence supporting the safety and metabolic benefits of PCL in general surgery,

while outcomes for bowel recovery, LOS and complications remain heterogeneous.

Patient comfort

All six recent RCTs confirmed reductions in preoperative thirst, hunger and fatigue with PCL.[5,8-12,23,24,32] These findings corroborate earlier reports by Hausel et al, Yilmaz et al, Ludwig et al and Smith et al, reinforcing comfort as the most reliable benefit.[9,11,12,21,24,32]

Metabolic stress

Kumar et al and Rizvanović et al demonstrated reductions in postoperative insulin resistance and inflammatory markers, aligning with prior studies by Nygren et al, Ljungqvist et al, Ljungqvist et al, Noblett et al, Wang et al, Dock-Nascimento et al and Breuer et al.[2,3,5,6,15-18,20,27,34] Such effects may contribute to faster functional recovery.[4,19,22]

Length of stay and complications

Mixed results were observed. While Rizvanović et al, reported markedly fewer severe complications, Suh et al and Li et al, did not.[5,36,38] Earlier meta-analyses by Bilku et al and Smith et al, also showed inconsistent LOS benefits, suggesting context-specific effects depending on surgical type and ERAS implementation.[5,6,9,10,21,29]

Diabetic patients

Li et al and Vishak et al showed that PCL with insulin protocols is safe in type-2 diabetics, improving comfort without worsening glycemic control.[38,39]

This builds on earlier evidence by Jones et al, Gustafsson et al, Cho et al and Svanfeldt et al supporting broader inclusion of diabetic patients in ERAS nutrition protocols.[13,14,25,26]

Integration with ERAS

The Liu et al, trial highlighted that combining PCL with goal-directed fluid therapy yields stronger improvements, suggesting synergy with multimodal optimization strategies.[37] This reflects ERAS guidelines by Fearon et al, Gustafsson et al, Nelson et al and Lassen et al, which emphasize bundled care over isolated interventions.[5,6,28,30] Similar findings were reported in Zhuang et al and Osugi et al, reinforcing the concept of synergistic perioperative optimization.[22,27]

Limitations

Heterogeneity in surgical populations, sample sizes and CHO regimens limits generalizability.[5,6] Blinding is inherently difficult due to taste differences.[23,24] Longer-term outcomes, such as sustained glycemic control and late complication rates, remain underexplored.[31,33,35]

CONCLUSION

In adult general surgery, preoperative carbohydrate loading is a safe, well-tolerated alternative to prolonged fasting. It reliably improves patient comfort and metabolic stress profiles, though effects on length of stay and complications vary.

The strongest evidence supports its role as part of multimodal ERAS pathways rather than as a stand-alone intervention. Future research should refine protocols for elderly and diabetic patients and explore synergistic benefits with fluid therapy, early feeding and other perioperative strategies.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not requited

REFERENCES

1. Maltby JR. Fasting from midnight—the history behind the dogma. Best Pract Res Clin Anaesthesiol. 2006;20(3):363–78.
2. Nygren J. Preoperative fasting and carbohydrate treatment before surgery. Nutrition. 1997;13(6):467–9.
3. Ljungqvist O. Insulin resistance and outcomes in surgery. J Clin Endocrinol Metab. 2010;95(9):4217–9.
4. Soop M. Preoperative oral carbohydrate treatment attenuates insulin resistance. Clin Nutr. 2001;20(2):107–11.
5. Fearon KC. Enhanced recovery after surgery (ERAS): consensus review. Clin Nutr. 2005;24(3):466–77.
6. Gustafsson UO. ERAS Society guidelines for perioperative care. World J Surg. 2020;44(1):3–10.
7. American Society of Anesthesiologists. Practice guidelines for preoperative fasting. Anesthesiology. 2017;126(3):376–93.
8. Awad S. Meta-analysis of preoperative carbohydrate loading in elective surgery. Br J Surg. 2013;100(13):1701–8.
9. Smith MD. Preoperative carbohydrate treatment for enhanced recovery. Cochrane Database Syst Rev. 2014;(8):9161.
10. Bilku DK. Meta-analysis of carbohydrate drinks and postoperative outcomes. Ann Surg. 2014;259(4):431–7.
11. Yilmaz N. Carbohydrate loading in surgery: A review. J Clin Anesth. 2013;25(1):47–52.
12. Hausel J. A carbohydrate-rich drink reduces preoperative discomfort. Clin Nutr. 2005;24(6):998–1004.
13. Jones C. Carbohydrate loading in type-2 diabetes: safety and effects. Clin Nutr. 2012;31(6):798–804.
14. Gustafsson UO. Carbohydrate drinks in ERAS for colorectal surgery. Dis Colon Rectum. 2008;51(7):933–40.

15. Nygren J. Carbohydrate drinks and insulin resistance after surgery. Am J Physiol Endocrinol Metab. 1999;276:874–81.
16. Wang ZG. Oral carbohydrate reduces insulin resistance in GI surgery. Chin Med J. 2010;123(18):2530–4.
17. Dock-Nascimento DB. Carbohydrate beverage reduces metabolic stress. Nutrition. 2012;28(9):901–7.
18. Ljungqvist O, Nygren J, Thorell A. Metabolic modulation by preoperative nutrition. Curr Opin Clin Nutr Metab Care. 2001;4(1):13–7.
19. Henriksen MG. Randomized study of carbohydrate drinks and postoperative outcomes. Acta Anaesthesiol Scand. 2003;47(7):884–91.
20. Noblett SE. Carbohydrate drinks reduce insulin resistance in colorectal surgery. Br J Surg. 2006;93(12):1388–95.
21. Smith MD. ERAS and carbohydrate loading: meta-analysis. Br J Surg. 2018;105(8):936–48.
22. Osugi H. Carbohydrate treatment and immune function after esophagectomy. Ann Surg. 2006;244(1):16–22.
23. Yamaguchi T. Carbohydrate drink attenuates IL-6 rise after gastrectomy. Surg Today. 2011;41(8):1011–5.
24. Hausel J. Carbohydrate drinks reduce anxiety before elective surgery. Anesth Analg. 2001;93(5):1344–50.
25. Cho YJ. Carbohydrate loading in elderly patients: randomized trial. Korean J Anesthesiol. 2015;68(6):543–9.
26. Svanfeldt M. Oral carbohydrate drinks and protein metabolism. Clin Nutr. 2007;26(5):589–95.
27. Nygren J. The metabolic rationale for carbohydrate drinks. Curr Opin Clin Nutr Metab Care. 2006;9(6):612–6.
28. Zhuang CL. ERAS program with carbohydrate loading in GI surgery. Int J Colorectal Dis. 2013;28(10):1327–35.
29. Nelson G. Guidelines for perioperative care in colorectal surgery. Dis Colon Rectum. 2019;62(2):142–53.
30. Lassen K. Preoperative fasting and carbohydrate drinks: Scandinavian guidelines. Acta Anaesthesiol Scand. 2006;50(5):587–90.
31. Soreide E. Preoperative carbohydrate treatment reduces thirst and anxiety. Acta Anaesthesiol Scand. 2005;49(8):1110–6.
32. Ludwig T. Patient-reported outcomes with carbohydrate loading. Eur J Anaesthesiol. 2013;30(5):306–13.
33. Hester RL. Metabolic consequences of preoperative carbohydrate drinks. Nutrition. 2012;28(7–8):653–60.
34. Breuer JP. Carbohydrate loading improves perioperative insulin sensitivity. Acta Anaesthesiol Scand. 2006;50(8):913–8.
35. Laffin M. Patient experience and carbohydrate loading: qualitative synthesis. Perioper Med. 2018;7:6.
36. Suh S, Hetzel E, Alter-Troilo K, Lak K, Gould JC, Kindel TL. The influence of preoperative carbohydrate loading on postoperative outcomes in bariatric surgery patients: a randomized, controlled trial. Surg Obes Rel Dis. 2021;17(8):1480-8.
37. Liu X, Zhang P, Liu MX, Ma JL, Wei XC, Fan D. Preoperative carbohydrate loading and intraoperative goal-directed fluid therapy for elderly patients undergoing open gastrointestinal surgery: a prospective randomized controlled trial. BMC Anesthesiol. 2021;21(1):157.
38. Li X, Liu L, Liang XQ, Li YT, Wang DX. Preoperative carbohydrate loading with individualized supplemental insulin in diabetic patients undergoing gastrointestinal surgery: A randomized trial. Int J Surg. 2022;98:106215.
39. Vishak M, Gayathri B, Chandrasekhar G, Ramani S, Chandrasekhar GK, Ramani S. Randomized controlled trial comparing the effects of preoperative carbohydrate and non-carbohydrate loading on gastric emptying in diabetic and non-diabetic patients posted for elective surgery. Cureus. 2023;15(11):49213.
40. Rizvanović N, Nesek Adam V, Kalajdžija M, Čaušević S, Dervišević S, Smajić J. Effects of preoperative oral carbohydrate loading on neutrophil/lymphocyte ratio and postoperative complications following colorectal cancer surgery: a randomized controlled study. European Surg Res. 2023;64(2):278-85.
41. Kumar SM, Anandhi A, Sureshkumar S, Keerthi AR, Raja K, Jha AK, et al. Effect of preoperative oral carbohydrate loading on postoperative insulin resistance, patient-perceived well-being, and surgical outcomes in elective colorectal surgery: a randomized controlled trial. J Gastroint Surg. 2024;28(10):1654-60.

Cite this article as: Marcuccilli J, Jatczak N. Preoperative carbohydrate loading vs fasting: effects on postoperative recovery and outcomes in surgery. Int Surg J 2025;12:1753-8.