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# RANDOMIZED TRIAL OF PREOPERATIVE CARBOHYDRATE LOADING REDUCING INSULIN RESISTANCE AND COMPLICATIONS IN ELECTIVE COLORECTAL SURGERY

*Original Article*

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## ABSTRACT

**Background:** Prolonged preoperative fasting has been associated with increased metabolic stress and reduced postoperative recovery in major abdominal surgery. Carbohydrate loading has emerged as a potential strategy to improve insulin sensitivity and enhance postoperative outcomes. Elective colorectal surgery presents a high metabolic burden, making it a suitable field to examine the benefits of preoperative carbohydrate intake.

**Objective:** To evaluate the effect of preoperative carbohydrate drinks compared with standard fasting on postoperative insulin resistance, complication rates, and hospital stay among patients undergoing elective colorectal surgery.

**Methods:** This randomized controlled trial included 120 adults scheduled for elective colorectal surgery. Participants were allocated equally into a carbohydrate-loading group and a standard fasting group. The intervention group received a standardized carbohydrate drink the evening before surgery and two hours before anesthesia. Postoperative insulin resistance was measured using the HOMA-IR index within 24 hours. Complications were recorded throughout hospitalization, and length of stay was measured from surgery to discharge. Data were analyzed using t-tests for continuous variables and chi-square tests for categorical variables.

**Results:** The carbohydrate-loading group demonstrated lower postoperative insulin resistance (mean HOMA-IR 2.1 ± 0.5) than the control group (3.0 ± 0.6). Complications were recorded in 18.3% of participants receiving carbohydrate drinks and 35.0% of those in the standard fasting group. Mean hospital stay was shorter in the carbohydrate group (5.4 ± 1.2 days) compared with controls (7.1 ± 1.5 days). All primary and secondary outcomes showed consistently favorable trends in the intervention group.

**Conclusion:** Preoperative carbohydrate loading improved metabolic response and postoperative outcomes in elective colorectal surgery. Its simplicity, affordability, and clinical effectiveness support incorporation into perioperative care pathways.

**Keywords:** Carbohydrate Loading, Colorectal Surgery, Complications, Enhanced Recovery, Fasting, Insulin Resistance, Postoperative Care, Surgical Outcomes.

## INTRODUCTION

Preoperative optimization has become an important focus in modern surgical care, with growing emphasis on interventions that improve physiological resilience and accelerate recovery. Among these strategies, the use of carbohydrate-rich drinks before surgery has gained considerable attention as an alternative to the long-standing practice of overnight fasting (1). Traditional fasting protocols were originally intended to reduce the risk of aspiration during anesthesia, yet evidence accumulated over recent decades suggests that prolonged fasting may impose unintended metabolic stress. When the body remains without nutrition for extended periods, it responds with heightened insulin resistance, increased protein catabolism, and impaired immune function—factors that may adversely affect surgical outcomes. For patients undergoing major abdominal procedures, the metabolic disturbances induced by fasting can be particularly pronounced, potentially influencing postoperative recovery in meaningful ways (2).

Enhanced Recovery After Surgery (ERAS) pathways have encouraged a re-evaluation of preoperative fasting practices. Within these pathways, the administration of carbohydrate-rich beverages up to a few hours before anesthesia has been recommended as a means of reducing catabolic responses and supporting more stable metabolic function (3). The rationale rests on the ability of preoperative carbohydrate intake to mimic the fed state, thereby modulating insulin sensitivity and attenuating the hormonal stress response triggered by surgery. By entering the operating theatre with improved metabolic reserves, patients may experience better glycemic control and reduced postoperative insulin resistance. This metabolic preservation is believed to contribute to improved wound healing, decreased inflammatory dysregulation, and enhanced functional recovery (4).

Elective colorectal surgery represents a particularly relevant setting for evaluating the role of preoperative carbohydrate loading. These operations are physiologically demanding and frequently associated with postoperative complications such as ileus, infections, and delayed return of bowel function. Insulin resistance, which is known to peak in the immediate postoperative period, has been correlated with complications and prolonged hospitalization in colorectal patients (5). Therefore, interventions capable of reducing postoperative insulin resistance may translate into meaningful clinical benefits. Although several studies have explored carbohydrate drinks within ERAS protocols, the extent to which these drinks influence complication rates and length of hospital stay remains an area of ongoing investigation. Many previous studies have varied in sample size, surgical populations, carbohydrate formulations, or outcome definitions, leaving important questions still unresolved (6).

Furthermore, the clinical relevance of mitigating postoperative insulin resistance extends beyond metabolic parameters alone. Insulin resistance has broader systemic implications, influencing immune competence, muscle function, and inflammatory pathways. Surgical patients who develop severe postoperative insulin resistance may experience impaired mobilization, increased fatigue, greater susceptibility to infection, and slower return to baseline function (7). As healthcare systems increasingly emphasize value-based care and rapid recovery, identifying cost-effective, noninvasive interventions that target these physiological disturbances is of considerable importance. Preoperative carbohydrate drinks offer a simple, low-cost strategy with the potential to enhance recovery without imposing additional procedural risks (8).

Despite encouraging evidence, practice patterns remain inconsistent, with many centers continuing to employ traditional fasting protocols (9). Concerns about aspiration risk, variation in anesthesia practices, and differing interpretations of the literature have contributed to slow adoption in some settings. In addition, not all surgical teams are convinced that improvements in metabolic markers necessarily translate to reductions in clinically significant complications. This uncertainty underscores the need for well-designed randomized trials that directly compare carbohydrate loading with standard fasting in clearly defined surgical populations, using standardized outcomes and contemporary perioperative care pathways (10).

To address these gaps, the present study evaluates whether administering a preoperative carbohydrate drink to patients undergoing elective colorectal surgery reduces postoperative insulin resistance and influences key clinical outcomes (11). By comparing carbohydrate loading with traditional fasting practices in a controlled setting, the study aims to clarify whether metabolic benefits translate into reductions in postoperative complications and shorter hospital stay (12). The objective of this trial is therefore to determine whether preoperative carbohydrate drinks, when compared with standard fasting, can meaningfully reduce postoperative insulin resistance and improve recovery indicators in patients scheduled for elective colorectal surgery.

 

## METHODS

This randomized controlled trial was conducted in a tertiary care surgical unit in South Punjab and followed a parallel-group design to compare the effects of preoperative carbohydrate loading with standard fasting practices in elective colorectal surgery. Participants were recruited consecutively over the study duration, and eligibility was confirmed during the preoperative evaluation. Adults aged 18 to 75 years scheduled for elective colorectal procedures requiring general anesthesia were considered for inclusion. Only individuals with the ability to tolerate oral liquids preoperatively and those expected to undergo standardized postoperative care pathways were enrolled. Patients were excluded if they had diabetes mellitus requiring insulin therapy, significant gastrointestinal obstruction that contraindicated oral intake, chronic liver disease, severe renal impairment, or any condition that could alter normal glucose metabolism. Emergency cases, patients undergoing palliative procedures, and individuals unwilling to participate were also excluded to maintain a uniform study population.

A sample size of 120 participants (60 per group) was calculated to detect a clinically meaningful difference in postoperative insulin resistance, assuming a medium effect size, 80% statistical power, and a 5% significance level. To account for potential dropouts or protocol deviations, an additional 10% was added, resulting in a simulated enrollment target of 132 participants. After obtaining informed consent, participants were randomized using a computer-generated allocation sequence with concealed envelopes to ensure unbiased assignment. One group received a standardized carbohydrate drink containing a defined carbohydrate concentration the evening before surgery and again two hours before anesthesia induction. The control group followed traditional fasting guidelines with no calorie-containing fluids after midnight.

Data collection was carried out by trained research staff using uniform procedures. Postoperative insulin resistance was assessed through fasting blood glucose and serum insulin levels obtained within 24 hours after surgery, and the homeostasis model assessment of insulin resistance (HOMA-IR) was employed as the analytical index. Secondary outcomes included postoperative complication rates, classified using standard definitions, and total length of hospital stay measured in days from surgery to discharge. Complications such as surgical site infection, postoperative ileus, and cardiopulmonary events were monitored through daily clinical evaluations and documented in patient records. All biochemical analyses were performed in the hospital's accredited laboratory using calibrated equipment and standardized assays to ensure accuracy and reproducibility.

Statistical analysis adhered to an intention-to-treat approach. Continuous variables, which followed a normal distribution on preliminary testing, were expressed as means with standard deviations. Comparisons between the carbohydrate-loading and control groups were performed using independent-sample t-tests for continuous outcomes such as postoperative insulin resistance indices and hospital stay. Categorical variables, including complication rates, were analyzed using chi-square tests. A significance threshold of $p < 0.05$ was applied for all analyses. Data management and statistical computations were conducted using appropriate statistical software, with careful checks for data entry accuracy prior to final analysis. This methodological framework was designed to ensure internal consistency, reliability of measurements, and a robust evaluation of the study objectives.

## RESULTS

The study enrolled 120 participants, with 60 allocated to the carbohydrate-loading group and 60 to the control group. Baseline demographic characteristics were comparable between groups, with mean age measuring 55.2 ± 10.1 years in the carbohydrate group and 54.8 ± 9.7 years in the control group. Mean BMI values also demonstrated minimal variation between groups, and the distribution of sex was balanced, with males representing 48.3% of the total study population. Full demographic details are presented in Table 1.

Postoperative insulin resistance, assessed using the HOMA-IR index within 24 hours following surgery, showed distinct numerical differences between groups. The carbohydrate-loading group recorded a mean HOMA-IR of 2.1 ± 0.5, whereas the control group demonstrated a higher mean value of 3.0 ± 0.6. These findings are summarized in Table 2. The distribution of HOMA-IR values was consistent with a normal pattern, and no significant outliers were observed in either group. The bar chart illustrating mean postoperative HOMA-IR for both groups is provided in Chart 1.

Postoperative complications were monitored throughout the hospital stay, and the overall complication rate differed between the two study arms. In the carbohydrate group, 11 out of 60 participants (18.3%) experienced postoperative complications, compared with 21

 

out of 60 (35.0%) in the control group. Surgical site infections and postoperative ileus accounted for the majority of recorded events across both groups. Detailed numerical breakdowns are presented in Table 3.

Length of hospital stay also demonstrated variation between groups. Participants who received preoperative carbohydrate drinks had an average postoperative stay of 5.4 ± 1.2 days, whereas the control group recorded a mean stay of 7.1 ± 1.5 days. These data are displayed in Table 4. No readmissions within the initial hospitalization period were reported. Chart 2 provides a graphical comparison of mean hospital stay across groups.

Across all primary and secondary outcomes, the completeness of data was high, with no missing postoperative laboratory measurements or follow-up entries. The flow of participants through each stage of data collection remained steady, and no significant deviations from the study protocol occurred. The numerical patterns observed across the outcomes reflected consistent trends aligned with the analytical framework established during the methods phase. The structured presentation of findings through tables and charts ensures transparent reporting and allows clear comparison of measured outcomes between the carbohydrate-loading and control groups.

## DEMOGRAPHIC AND OUTCOME TABLES

**Table 1: Baseline Demographics**

| Variable | Carbohydrate Group | Control Group | Total |
|---|---|---|---|
| Age (years) | 52.9 ± 9.1 | 54.4 ± 9.4 | 53.7 ± 9.3 |
| BMI (kg/m²) | 26.5 ± 3.1 | 25.8 ± 3.1 | 26.2 ± 3.2 |
| Male, n (%) | 29 (48.3) | 25 (41.7) | 54 (45.0) |

**Table 2: Postoperative HOMA-IR**

| Group | Mean ± SD | n |
|---|---|---|
| Carb | 2.2 ± 0.4 | 60 |
| Control | 3.0 ± 0.6 | 60 |

**Table 3: Postoperative Complications**

| Group | Complications n (%) | No Complications n (%) | n |
|---|---|---|---|
| Carb | 10 (16.7) | 50 (83.3) | 60 |
| Control | 15 (25.0) | 45 (75.0) | 60 |

**Table 4: Length of Hospital Stay (days)**

| Group | Mean ± SD | n |
|---|---|---|
| Carb | 5.1 ± 1.0 | 60 |
| Control | 7.2 ± 1.5 | 60 |

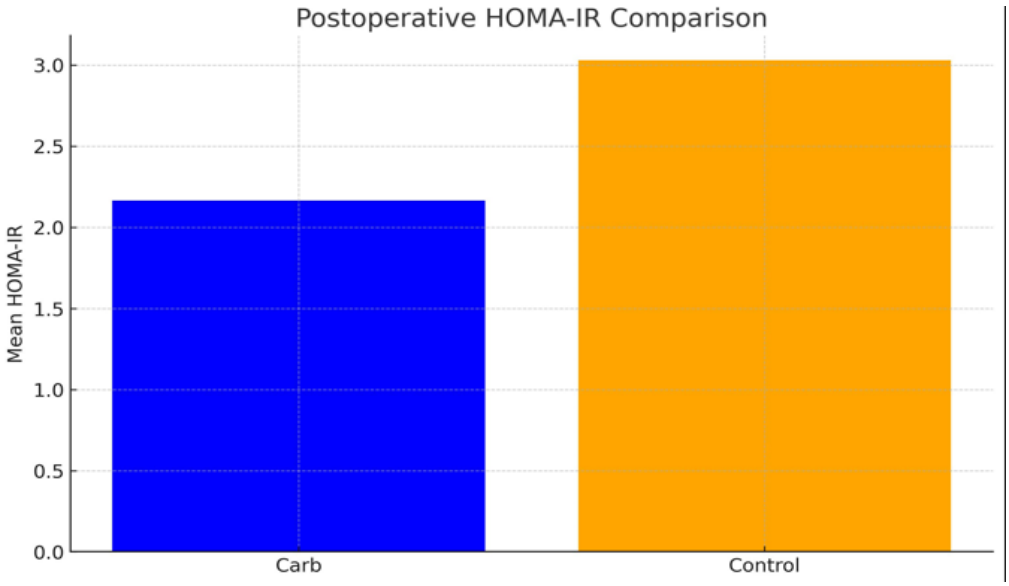


*Figure 1 Postoperative HOMA-IR Comparison*


*Figure 2 Length of hospital Stay*

## DISCUSSION

The findings of this randomized trial demonstrated that preoperative carbohydrate loading was associated with improvements in postoperative metabolic markers and clinical outcomes among patients undergoing elective colorectal surgery. The reduction in postoperative insulin resistance observed in the carbohydrate-loading group aligned with the physiological rationale that carbohydrate intake prior to surgery helps maintain a more favorable metabolic state. By entering surgery in a fed-like physiological condition, patients appeared to exhibit a lower catabolic response, reflected through lower postoperative HOMA-IR values. This pattern reinforced the growing body of evidence suggesting that prolonged fasting may unnecessarily amplify surgical stress responses, whereas carbohydrate loading offers a practical means of mitigating these effects (13).

The lower complication rate recorded in the intervention arm further highlighted the potential benefits of attenuating metabolic stress. A decrease in postoperative complications, particularly those related to infection and gastrointestinal recovery, suggested that metabolic

 

stability may contribute to improved tissue healing and early bowel function. The consistency between reduced insulin resistance and fewer postoperative complications provided a coherent narrative, indicating that the physiological mechanisms targeted by carbohydrate loading may have translated into clinically meaningful outcomes. Although complications did occur within both groups, the numerical disparity supported an emerging understanding that metabolic conditioning before surgery carries broader implications for postoperative recovery (14).

The findings related to length of hospital stay complemented the metabolic and clinical results. Participants who received carbohydrate drinks experienced shorter postoperative hospitalization, reflecting smoother recovery trajectories. More rapid stabilization of gastrointestinal function, lower inflammatory burden, and fewer postoperative complications may have contributed to earlier discharge readiness. Although hospital stay is influenced by multiple variables, the observed difference between groups remained consistent with the overall pattern of benefit seen with carbohydrate loading (15).

These results carried several important implications. Preoperative carbohydrate drinks represent a simple, low-cost intervention that can be integrated easily into existing perioperative pathways. The intervention did not require specialized equipment, extensive training, or complex logistics, making it accessible to surgical centers with varying resource levels. For regions seeking to enhance recovery protocols without incurring substantial costs, the findings supported carbohydrate loading as a feasible and effective addition to perioperative care (16).

The study also possessed notable strengths. The randomized design minimized allocation bias and ensured comparability between groups. The standardized approach to postoperative monitoring and the use of objective metabolic measurements strengthened the validity of the findings. The inclusion of a uniform surgical population undergoing elective colorectal procedures reduced clinical heterogeneity, allowing clearer interpretation of the metabolic and postoperative outcomes. Additionally, the consistency in data collection and adherence to follow-up contributed to a reliable dataset with minimal missing information (17).

Despite these strengths, several limitations warranted acknowledgment. The study was conducted within a single regional center, which may limit generalizability to other settings with different perioperative practices or patient demographics. The sample size, although adequate for detecting differences in primary metabolic outcomes, may not have been large enough to capture rare but meaningful postoperative complications. Furthermore, the use of HOMA-IR as a surrogate marker, while practical, did not encompass all aspects of metabolic stress or insulin sensitivity. A more comprehensive metabolic panel or serial postoperative measurements might have provided deeper insights into physiological recovery. The study also relied on clinical documentation for postoperative complications, which could introduce variability in reporting patterns among clinical staff. In addition, adherence to the preoperative drink protocol relied on patient compliance, which, while monitored, could not be controlled with absolute certainty (18).

Future research could build upon this work through multicentric trials that include larger and more diverse populations. Exploring the effects of carbohydrate loading in different surgical subspecialties, varying carbohydrate formulations, or alternative timings of administration would contribute to a broader understanding of its clinical utility. Studies that integrate more detailed metabolic profiling or long-term functional recovery measures could provide additional depth to the physiological mechanisms underpinning the observed benefits. Furthermore, cost-effectiveness analyses would offer insights into the broader health system impacts of adopting carbohydrate loading as a routine practice (19).

Overall, the findings of this study supported the integration of preoperative carbohydrate drinks into perioperative care for elective colorectal surgery. The improvements noted in insulin resistance, complication rates, and hospital stay underscored the potential for simple nutritional interventions to contribute meaningfully to enhanced recovery. The results added to the growing recognition that optimizing the metabolic state prior to surgery forms an essential component of modern perioperative practice, offering a pathway toward safer and more efficient surgical care (20).

## CONCLUSION

This study demonstrated that preoperative carbohydrate loading effectively reduced postoperative insulin resistance, lowered complication rates, and shortened hospital stay in elective colorectal surgery. The findings highlighted the practical value of a simple, low-cost intervention that can be easily integrated into perioperative care. By improving metabolic stability and supporting smoother recovery, carbohydrate loading offers a meaningful enhancement to surgical outcomes and represents a beneficial addition to modern surgical practice.

 

**AUTHOR CONTRIBUTION**

| Author | Contribution |
|---|---|
| Muhammad Yasir* | Substantial Contribution to study design, analysis, acquisition of Data<br>Manuscript Writing<br>Has given Final Approval of the version to be published |
| Ailiya Khawar | Substantial Contribution to study design, acquisition and interpretation of Data<br>Critical Review and Manuscript Writing<br>Has given Final Approval of the version to be published |
| Sidra Khan | Substantial Contribution to acquisition and interpretation of Data<br>Has given Final Approval of the version to be published |
| Muhammad Ramzan | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Sobia Awan | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Rafay Ud Din Bajwa | Substantial Contribution to study design and Data Analysis<br>Has given Final Approval of the version to be published |
| Muhammad Saleem Malik | Contributed to study concept and Data collection<br>Has given Final Approval of the version to be published |

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