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Impact of Preoperative Carbohydrate Loading on Early Postoperative Recovery in Patients Following Laparoscopic Cholecystectomy

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Abstract | **Original Research Article**

Background: Cholecystectomy, the surgical removal of the gallbladder, is one of the most commonly performed procedures for the management of cholelithiasis, with laparoscopic cholecystectomy widely recognized as the standard approach for patients with symptomatic gallstones. The present study aimed to evaluate the impact of preoperative carbohydrate loading on early postoperative recovery outcomes, including pain, analgesic requirement, nausea and vomiting, and time to ambulation and oral intake, in patients undergoing laparoscopic cholecystectomy. ***Aim of the study:*** The aim of the study was to evaluate the effect of preoperative carbohydrate loading on early postoperative recovery outcomes in patients undergoing laparoscopic cholecystectomy. ***Methods:*** This prospective observational study at the Department of General Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, included 70 elective laparoscopic cholecystectomy patients (ASA I–II). The intervention group (n=35) received 400 mL of 12.5% glucose 2 hours preoperatively; controls fasted. Outcomes were postoperative pain (VAS), analgesic use, nausea, vomiting, and recovery times. Data were analyzed with t-tests and Chi-square tests ($p < 0.05$). ***Results:*** In 70 patients, groups were comparable in age, sex, BMI, surgery duration, and ASA grade ($p > 0.05$). Carbohydrate loading reduced VAS scores at 6–24 h (4.5–2.8 vs. 5.1–3.3, $p < 0.05$), mean analgesic doses (2.8 vs. 3.5, $p = 0.001$), nausea (22.9% vs. 54.3%), vomiting (8.6% vs. 31.4%), and hastened ambulation (5.2 vs. 6.8 h) and oral intake (7.1 vs. 9.3 h, $p < 0.019$). ***Conclusion:*** Preoperative carbohydrate loading before laparoscopic cholecystectomy reduces postoperative pain and analgesic use, decreases nausea and vomiting, and accelerates recovery.

Keywords: Preoperative Carbohydrate Loading, Early Postoperative Recovery, Laparoscopic Cholecystectomy.

INTRODUCTION

Cholecystectomy, the surgical removal of the gallbladder, is one of the most frequently performed procedures for the management of cholelithiasis, despite the availability of non-surgical treatment options, with nearly 300,000 operations performed annually in the United States [1]. Since 1992, laparoscopic cholecystectomy has become the standard approach for patients with symptomatic gallstones, accounting for approximately 96% of these surgeries [2]. While minimally invasive, laparoscopic cholecystectomy is still associated with common postoperative complications such as pain, nausea, and vomiting, which can significantly impact patient comfort, delay recovery, and prolong hospital stay [3,4].

Traditionally, patients are instructed to fast from the night before surgery to reduce the risk of aspiration during anesthesia. However, prolonged fasting can result in significant preoperative discomfort, including hunger, thirst, anxiety, and weakness [5,6]. It also promotes catabolic metabolism, muscle breakdown, hyperglycemia, and insulin resistance [7]. Surgical stress further exacerbates insulin resistance, particularly on the first postoperative day, with effects potentially lasting up to three weeks, which can hinder early postoperative recovery and delay return to normal activities [8,9].

Preoperative carbohydrate loading has been proposed as a strategy to mitigate the adverse effects of prolonged fasting. Evidence indicates that consuming a carbohydrate-rich drink before surgery improves metabolic responses, reduces insulin resistance, and promotes an anabolic state [10–12]. Furthermore, preoperative carbohydrate intake has been associated with reductions in postoperative nausea, vomiting, and pain, as well as improvements in patient comfort and functional recovery [13–16]. By modulating the metabolic and stress responses to surgery, carbohydrate loading may facilitate earlier ambulation, quicker resumption of oral intake, and overall enhanced early postoperative recovery.

Despite accumulating evidence, most studies have primarily addressed metabolic outcomes or insulin resistance, with limited research specifically evaluating the impact of preoperative carbohydrate loading on early postoperative recovery parameters in patients undergoing laparoscopic cholecystectomy. Variations in study design, timing of carbohydrate administration, and outcome measures have also led to inconsistent findings, leaving uncertainty about its clinical benefits for optimizing postoperative recovery.

Therefore, this study was designed to address this gap. The purpose of the study was to evaluate the impact of preoperative carbohydrate loading on early postoperative recovery, including pain intensity, analgesic requirements, postoperative nausea and vomiting, time to first ambulation, and time to first oral intake, in patients undergoing laparoscopic cholecystectomy.

Objective

- To evaluate the effect of preoperative carbohydrate loading on early postoperative recovery outcomes in patients undergoing laparoscopic cholecystectomy.

Methodology & Materials

This prospective observational study was conducted in the Department of General Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from February 2023 to January 2024. Seventy patients with cholelithiasis scheduled for elective laparoscopic cholecystectomy were enrolled. Participants were divided into two groups: the control group (n = 35) fasted from midnight before surgery, while the intervention group (n = 35) received 400 mL of a 12.5% glucose carbohydrate drink 2 hours preoperatively.

Inclusion Criteria:

- Age 18–65 years, any gender
- ASA physical status I–II
- Elective laparoscopic cholecystectomy for cholelithiasis

Exclusion Criteria:

- Previous upper abdominal surgery affecting recovery
- Diabetes mellitus
- Pregnancy or lactation
- Conversion to open surgery
- Use of patient-controlled or preemptive analgesia

All patients underwent standard four-port laparoscopic cholecystectomy under uniform anesthetic and surgical protocols, maintaining intra-abdominal pressure at 12–15 mmHg. The primary outcome of the study was early postoperative recovery, evaluated through postoperative pain intensity, total analgesic requirement, incidence of nausea and vomiting, time to first ambulation, and time to first oral intake. Preoperative carbohydrate loading was the independent variable, while age, gender, and BMI were considered potential confounders. Postoperative pain was assessed using the Visual Analogue Scale (VAS) at 6, 12, 18, and 24 hours. Analgesic timing, dose, and total consumption were recorded, along with recovery parameters.

Data were collected using a semi-structured questionnaire, with outcome assessors blinded to group allocation. Quantitative data were expressed as mean ± standard deviation and analyzed using unpaired t-tests, while qualitative data were expressed as frequencies and percentages and analyzed with Chi-square tests. A p-value < 0.05 was considered statistically significant. Analyses were performed using SPSS version 22.0. Ethical approval was obtained from the BSMMU Institutional Review Board, and written informed consent was secured from all participants. The study was conducted in accordance with the Declaration of Helsinki, ensuring patient confidentiality throughout.

Results

Table 1: Demographic Characteristics of the Study Population (n = 70)

Variable		Intervention Group (n = 35)		Control Group (n = 35)		p-value
		n	%	n	%	
Age (years)	<30	7	20.0	12	34.3	
	31–40	9	25.7	9	25.7	

	41–50	8	22.9	8	22.9	
	>50	11	31.4	6	17.1	
	Mean ± SD	**42.6 ± 12.6**		**37.6 ± 11.9**		^{a}0.121^{ns}
	Range (min, max)	**19, 65**		**19, 58**		
Sex	Male	12	34.3	15	42.9	^{b}0.425^{ns}
	Female	23	65.7	20	57.1	
BMI (kg/m²)	18.5–24.9	27	77.1	21	60.0	
	25.0–29.9	8	22.9	14	40.0	
	Mean ± SD	**23.7 ± 1.9**		**24.4 ± 1.9**		^{a}0.180^{ns}
	Range (min, max)	**20.6, 27.1**		**20.6, 27.5**		
Duration of Surgery (minutes)	**Mean ± SD**	**59.1 ± 13.8**		**61.0 ± 12.5**		^{a}0.564^{ns}

The demographic profile of the study population is presented in Table 1. The mean age of patients was 42.6 ± 12.6 years in the intervention group and 37.6 ± 11.9 years in the control group (p = 0.121). Females were predominant in both groups (65.7% vs. 57.1%, p = 0.425). The mean BMI was 23.7 ± 1.9 kg/m² in the intervention group and 24.4 ± 1.9 kg/m² in the control group (p = 0.180). The average duration of surgery was 59.1 ± 13.8 minutes in the intervention group and 61.0 ± 12.5 minutes in the control group (p = 0.564).

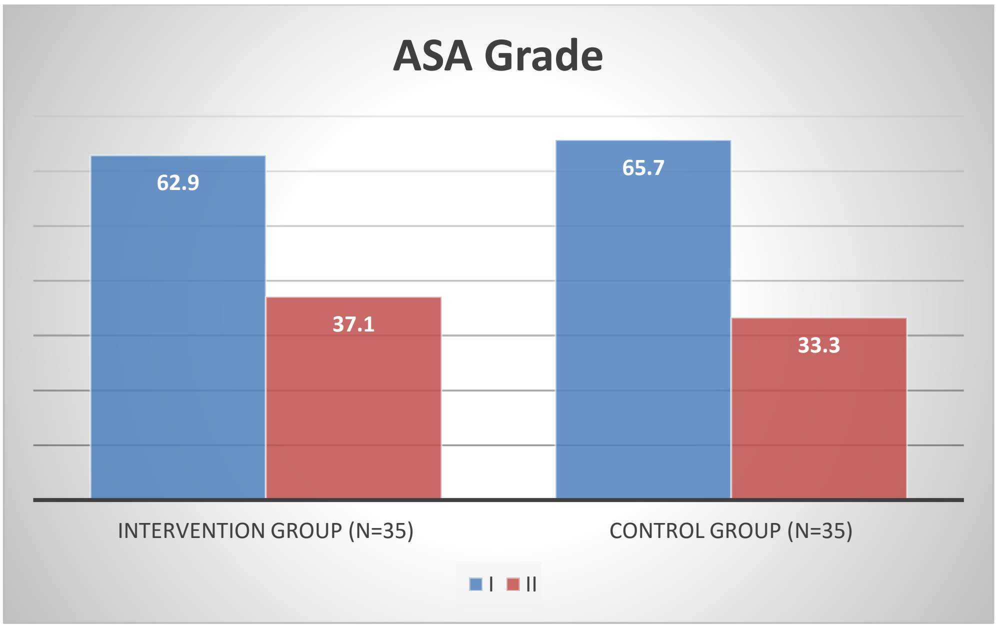

Figure 1: Distribution of Patients According to ASA Grade (n = 70)

Most patients in both groups were ASA grade I (62.9% in the intervention group and 65.7% in the control group), while the remainder were ASA grade II (37.1% and 34.3%, respectively). The distribution of ASA physical status was comparable between the two groups ($p = 0.786$).

Table 2: Postoperative Pain Intensity (VAS Score) and Early Recovery Outcomes at Different Time Intervals

Time After Surgery	Intervention Group (n = 35) Mean ± SD	Control Group (n = 35) Mean ± SD	p-value
6 hours	4.5 ± 0.7	5.1 ± 0.6	0.007^{s}
12 hours	4.9 ± 0.7	5.4 ± 0.7	0.014^{s}
18 hours	4.3 ± 0.8	4.3 ± 0.8	0.042^{s}
24 hours	2.8 ± 0.7	3.3 ± 0.6	0.012^{s}

Postoperative pain intensity, assessed using the Visual Analogue Scale (VAS), was consistently lower in patients who received preoperative carbohydrate loading. The mean VAS scores at 6, 12, 18, and 24 hours postoperatively were 4.5 ± 0.7, 4.9 ± 0.7, 4.3 ± 0.8, and 2.8 ± 0.7 in the intervention group, compared to 5.1 ± 0.6, 5.4 ± 0.7, 4.3 ± 0.8, and 3.3 ± 0.6 in the control group, respectively. These differences were statistically significant at all time points ($p < 0.05$).

Table 3: Analgesic Requirement Within 24 Hours Post-Surgery

Analgesic Requirement	Intervention Group (n=35)		Control Group (n=35)		P value
	n	%	n	%	
Two does	4	11.4	2	5.7	0.017[s]
Three doses	21	60.0	12	34.3	
Four doses	10	28.6	21	60.0	
Mean number of doses	2.8 ± 0.6		3.5 ± 0.6		0.001[s]

The total number of analgesic doses required within 24 hours was significantly lower in the intervention group (Table 3). Among those who received preoperative carbohydrates, 11.4% required two doses, 60% required three doses, and 28.6% required four doses, compared to 5.7%, 34.3%, and 60% in the control group, respectively. The mean number of doses was significantly reduced in the intervention group (2.8 ± 0.6) compared to the control group (3.5 ± 0.6, p = 0.001).

Table 4: Postoperative Recovery Parameters and Incidence of Nausea and Vomiting

Variable	Intervention Group (n = 35)	Control Group (n = 35)	P value
Nausea	8 (22.9%)	19 (54.3%)	b0.011[s]
Vomiting	3 (8.6%)	11 (31.4%)	b0.019[s]
Time to First Ambulation (hours)	5.2 ± 1.5	6.8 ± 1.9	a<0.001[s]
Time to First Oral Intake (hours)	7.1 ± 2.1	9.3 ± 2.4	a<0.001[s]

Postoperative recovery outcomes were notably improved in patients receiving preoperative carbohydrate loading (Table 4). The incidence of nausea and vomiting was significantly lower in the intervention group (22.9% and 8.6%) compared to the control group (54.3% and 31.4%) (p = 0.011 and p = 0.019, respectively). Additionally, patients in the intervention group experienced earlier ambulation (5.2 ± 1.5 vs. 6.8 ± 1.9 hours, p < 0.001) and earlier initiation of oral intake (7.1 ± 2.1 vs. 9.3 ± 2.4 hours, p < 0.001).

DISCUSSION

Postoperative recovery after laparoscopic cholecystectomy is often influenced by factors such as pain, nausea, delayed ambulation, and prolonged fasting. The present study demonstrates that preoperative carbohydrate loading can significantly enhance early postoperative recovery by reducing pain intensity, decreasing analgesic requirements, and minimizing postoperative nausea and vomiting. These findings suggest that optimizing preoperative metabolic and nutritional preparation contributes to faster recovery, improved patient comfort, and overall better postoperative outcomes following laparoscopic cholecystectomy.

The demographic characteristics of the present study showed comparable baseline profiles between the intervention and control groups in terms of age, sex distribution, BMI, and duration of surgery, with no statistically significant differences (p > 0.05). These findings align with those of Choi *et al.,*[17], who also found no significant differences between their fasting and carbohydrate-loading groups regarding age (58.06 ± 13.89 vs. 56.61 ± 12.06, p = 0.495), sex distribution (male 32.8% vs. 45.6%, p = 0.133), and BMI (23.87 ± 3.60 vs. 24.05 ± 4.29, p = 0.795). Similarly, Tavalaee *et al.,*[18] reported comparable demographic characteristics between groups, with no significant variation in gender distribution (p = 0.44) or group allocation (p = 0.99). The lack of significant baseline differences in the present study indicates effective matching between groups, supporting that observed differences in early postoperative recovery parameters were primarily due to the preoperative carbohydrate-loading intervention rather than demographic variability.

In the present study, the majority of patients in both groups were classified as ASA grade I (62.9% and 65.7%, respectively), followed by ASA grade II (37.1% and 34.3%), with no statistically significant difference between the groups (p = 0.786). This reflects a comparable preoperative physical status and operative risk profile among participants. Similarly, George *et al.,*[19] reported that most patients undergoing laparoscopic cholecystectomy were ASA grade I or II, emphasizing the predictive value of ASA classification for postoperative outcomes (p = 0.004). The comparable ASA distribution in the current study ensures that variations in early postoperative recovery parameters—such as pain intensity, mobilization, and return of oral intake—can be attributed to the effect of preoperative carbohydrate loading rather than differences in baseline surgical risk.

Postoperative pain intensity, assessed using the Visual Analogue Scale (VAS), was consistently lower in the carbohydrate-loaded group compared to the control group at all postoperative intervals, with significant differences observed at 6, 12, 18, and 24 hours (p < 0.05). These findings are consistent with those of Qazi *et al.,*[20], who demonstrated a significant reduction in postoperative pain among patients receiving preoperative carbohydrate drinks compared to fasting or placebo groups (SMD: −0.76; 95% CI: −1.35, −0.16; p = 0.01), and with Wang *et al.,*[16], who similarly reported lower postoperative pain scores in carbohydrate-loaded patients ($p = 0.006$). The consistent reduction in pain across studies underscores the beneficial role of preoperative carbohydrate loading in attenuating the surgical stress response, enhancing patient comfort, and contributing to smoother early postoperative recovery.

The total analgesic requirement within 24 hours was significantly lower in the carbohydrate-loaded group compared to the control group (mean 2.8 ± 0.6 vs. 3.5 ± 0.6 doses, $p = 0.001$), with fewer patients in the intervention group requiring four doses (28.6% vs. 60%). These findings are consistent with those of Kausar *et al.,*[21], who reported reduced postoperative acetaminophen consumption among patients receiving preoperative carbohydrate drinks, reinforcing the analgesic-sparing effect of this intervention. The observed reduction in analgesic requirement likely reflects the role of carbohydrate loading in promoting metabolic stability, minimizing the catabolic response to surgery, and thereby facilitating improved pain control and faster postoperative recovery.

Regarding postoperative recovery and side effects, patients in the carbohydrate-loaded group experienced significantly fewer incidences of nausea (22.9% vs. 54.3%, $p = 0.011$) and vomiting (8.6% vs. 31.4%, $p = 0.019$), along with earlier ambulation (5.2 ± 1.5 vs. 6.8 ± 1.9 hours, $p < 0.001$) and earlier initiation of oral intake (7.1 ± 2.1 vs. 9.3 ± 2.4 hours, $p < 0.001$). These findings align with those of Singh *et al.,*[22], who demonstrated reduced postoperative nausea, vomiting, and greater comfort among patients receiving preoperative carbohydrate loading, as well as Gök *et al.,*[23], who observed a significant decline in PONV incidence in the carbohydrate-supplemented group. Collectively, these results suggest that preoperative carbohydrate administration alleviates surgical stress, promotes faster gastrointestinal recovery, and contributes to enhanced overall postoperative outcomes.

Limitations of the study

The study had several limitations:

- Individual differences in pain perception and analgesic needs could have affected the recorded outcomes.
- The lack of blinding in the study design introduces the possibility of bias, which may have influenced pain reporting and assessment of results.
- Other potential confounders, including the use of adjunct pain management strategies or variations in patients' psychological status, were not evaluated and might have impacted postoperative pain outcomes.

CONCLUSION

Preoperative carbohydrate loading in patients undergoing laparoscopic cholecystectomy significantly improved early postoperative recovery. It reduced pain intensity, decreased analgesic consumption, and lowered the incidence of nausea and vomiting. Additionally, it facilitated faster recovery, evidenced by earlier ambulation and earlier resumption of oral intake. These findings indicate that preoperative carbohydrate supplementation enhances postoperative comfort and accelerates recovery.

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