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Original Article

Anaesthesia Section

Effect of 5% Dextrose Infusion on Postoperative Nausea and Vomiting in Patients undergoing Laparoscopic Cholecystectomy: A Randomised Controlled Study

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ABSTRACT

Introduction: Postoperative Nausea and Vomiting (PONV) is defined as nausea, vomiting, or retching occurring in the postanaesthesia care unit within the first 24 hours of postoperative period. It is most common following laparoscopic cholecystectomy, causing postoperative discomfort and increasing patients' stay in the postanaesthesia care unit.

Aim: To evaluate the effect of a 500 mL infusion of 5% dextrose on PONV in patients undergoing laparoscopic cholecystectomy.

Materials and Methods: A randomised controlled study was conducted at Department of Anaesthesiology, ESICMC PGIMSR, Bengaluru, Karnataka, India from January 2019 to June 2020, involving 90 consenting patients who were randomly assigned to two groups. One group (Group-C) received a 500 mL infusion of 5% dextrose, while the other group (Group-D) received Ringer's lactate 30 minutes before the end of surgery. Anaesthesia and surgical techniques were standardised for all cases. Postoperatively, primary parameters such as the incidence of nausea, vomiting, and retching, and secondary parameters such as rescue antiemetic consumption and changes in blood glucose changes were recorded. The Bellville scale was used to assess PONV. Data were analysed using the Chi-square (χ^2) test, with a significance level of 0.05. Continuous variables were reported as mean±Standard Deviation (SD), and categorical variables were reported as proportions.

Results: Demographic parameters such as age (p=0.601), gender (p=0.259), weight (p=0.802), height (p=0.391), and Body Mass Index (BMI) (p=0.806) were comparable between the two study groups. A 5% dextrose infusion during laparoscopic cholecystectomy reduced nausea and vomiting during the postoperative period (p<0.05), decreased the overall incidence of PONV (p<0.001), and also reduced the requirement for rescue antiemetic dose (p<0.004). When comparing blood sugar levels, Group-D and Group-C showed no significant difference at T1, but there was a significant difference between the both groups at T2 (T1: p=0.211, T2: p<0.001).

Conclusion: A 5% dextrose infusion during laparoscopic cholecystectomy reduces the incidence of PONV and decreases the need for rescue antiemetic medication. Additionally, comparing blood sugar levels, Group-D and Group-C showed a significant difference after the drug infusion. Therefore, a 5% dextrose infusion can be recommended as an effective and safe method for the prophylaxis of PONV in laparoscopic cholecystectomy.

Keywords: Antiemetic, Body mass index, Intravenous fluids, Prophylaxis

INTRODUCTION

The PONV is defined as nausea, vomiting, or retching in the postanaesthesia care unit within the first 24 hours of the postoperative period [1]. It is a common and distressing complication after anaesthesia and surgery, with a higher incidence of approximately 40% to 75% reported in laparoscopic surgeries [2]. Although PONV is self-limiting, it leads to considerable postoperative discomfort and dissatisfaction. General anaesthesia increases the incidence of PONV. Other risk factors for PONV include female gender, a history of motion sickness, non smoking status, opioids, and the duration and type of surgery. Given that patients undergoing laparoscopic cholecystectomy are at a higher risk of developing PONV, there has been increasing attention directed towards its prophylaxis in this population [3].

Several approaches, such as serotonin receptor (5-HT3) antagonists, dexamethasone, droperidol, promethazine, and some non pharmacologic techniques, have been tried for the prevention of PONV, but the optimal approach remains obscure [4].

The preoperative infusion of intravenous fluids, such as dextrose, can decrease dehydration-related insulin resistance, which is one of the underlying aetiologies for PONV [5]. Studies by Saleh AN et al., Jablameli M et al., Mishra A et al., and Lakhotia R et al., have shown that intravenous dextrose infusion reduces the incidence of PONV [1,5-7]. On the other hand, there are other studies, such as Zorrilla-Vaca A et al., Pin-on P et al., and Patel P et al., that have shown that dextrose infusion does not significantly reduce the incidence of PONV [8-10]. Despite several conducted studies, there is very limited and controversial evidence supporting the effectiveness of intravenous 5% dextrose administration in the prevention of PONV [5,6,10,11].

Therefore, the present study was conducted to evaluate the effect of intraoperative infusion of 5% dextrose-containing crystalloid on PONV in patients undergoing laparoscopic cholecystectomy under general anaesthesia.

MATERIALS AND METHODS

A randomised controlled study was conducted at ESIC Medical College- PGIMSR, Rajajinagar, Bengaluru, India, from January 2019 to June 2020. Ethical committee approval was obtained, and the Ethical committee approval number is No. 532/L/11/12/Ethics/ESICMC&PGIMSR/Estt. Vol. IV. Informed written consent was obtained from all patients.

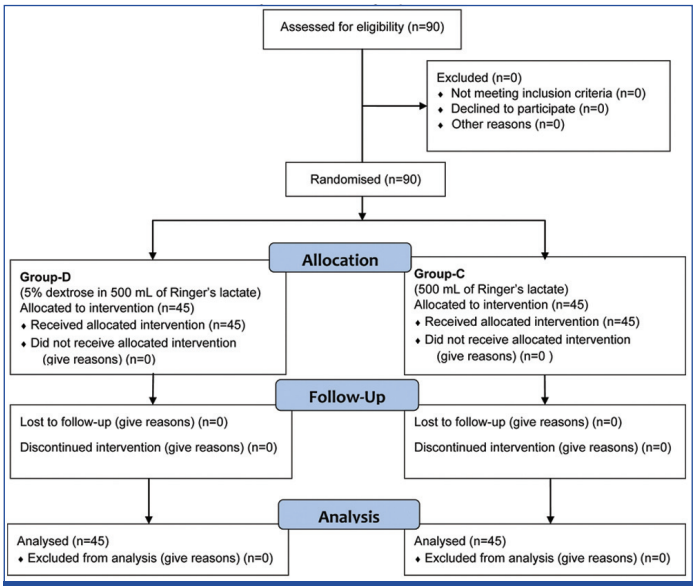
Sample size: A minimum of 42 patients were required in each group to detect a decrease in the incidence from 40% to 30% with 80% power and a significance level of 0.05 [6]. To account for potential dropouts, a total of 90 patients were enrolled, with 45 patients in each group and no potential dropouts.

Inclusion criteria: Patients of either gender belonging to the American Society of Anaesthesiologists (ASA) physical status 1 or 2, aged between 18-40 years, undergoing elective laparoscopic cholecystectomy surgery under general anaesthesia were included.

Exclusion criteria: Patients with a history of PONV, smoking, motion sickness, coagulopathy, diabetes mellitus, severe hypertension, cardiac, renal, or hepatic dysfunction, a duration of surgery of more than two hours, and those who were unable to understand the verbal rating scale were excluded from the study.

Study Procedure

A detailed preanaesthetic check-up was done on the day prior to surgery. All the patients were randomised into two groups (Group-C and Group-D) using a computer-generated random number table. The Consolidated Standards of Reporting Trials (CONSORT) flow diagram is provided [Table/Fig-1].



[Table/Fig-1]: CONSORT flow diagram showing participant flow through each stage of randomised controlled trial (enrollment, allocation, follow-up and data analysis).

Patients in Group-C received 500 mL of Ringer's lactate, while patients in Group-D received 5% dextrose in 500 mL of Ringer's lactate, administered half an hour before the end of surgery over a period of 30 minutes. The study fluid was prepared by an anaesthesiology resident (observer 1) who was not further involved in the study. A 5% dextrose in Ringer's lactate solution was prepared by adding 50 mL of 50% dextrose to 450 mL of Ringer's lactate [11].

All patients followed the standard fasting guidelines, remaining nil per oral for 6-8 hours for solid foods and two hours for clear fluids.

On the morning of surgery, once the patient was transferred to the operating room, venous access was established using an 18 G i.v. cannula in the non dominant hand, and i.v. Ringer's lactate infusion was initiated at a rate of 2 mL/kg/hr. Standard monitors, including three-electrode Electrocardiogram (ECG) monitoring lead II, capnography, Non Invasive Blood Pressure (NIBP), and pulse oximetry, were connected. Anaesthesia was induced using midazolam 0.02 mg/kg, fentanyl 2 mcg/kg, propofol 2-2.5 mg/kg, and vecuronium 0.15 mg/kg. The trachea was intubated with an appropriately sised endotracheal tube, and anaesthesia was maintained using 35% oxygen, 65% nitrous oxide, and 1-2% sevoflurane with positive pressure ventilation.

The surgery was performed using a standard approach, maintaining intra-abdominal pressure below 14 mmHg during pneumoperitoneum. All patients received 4 mg of i.v. ondansetron and a 1 g paracetamol infusion 30 minutes before emerging from anaesthesia. Residual neuromuscular block was reversed using neostigmine 50 mcg/kg and glycopyrrolate 1 mcg/kg. The trachea was extubated when the patient was awake.

Blood glucose was measured at baseline and after 30 minutes of study fluid infusion using a point-of-care device (ACCU-CHECK®) from Roche Pharmaceuticals.

In the postoperative period, observer 2 (who was involved in the study) assessed and documented PONV using the Bellville scale [Table/Fig-2]. The score was obtained at 1 hour, 3 hours, 6 hours, 12 hours, and 24 hours, and the time of the first request for antiemetic was recorded. Patients who reported a score of more than three received a rescue antiemetic of 4 mg ondansetron i.v., and this was also documented.

Score	Clinical assessment
1	No symptoms
2	Nausea, subjective unpleasant sensation with awareness of urge to vomit
3	Retching, spasmodic contraction of abdominal wall and diaphragm muscles without expulsion
4	Vomiting, the same as retching but with forceful expulsion of gastric contents

[Table/Fig-2]: Bellville postoperative nausea vomiting scale [12].

Postoperative pain was treated by a standard analgesic regimen, which included 1 g i.v. paracetamol every 8 hours, 75 mg diclofenac infusion every 12 hours, and 50 mg tramadol every 8 hours for all patients. The primary objective was to compare the incidence of postoperative nausea and vomiting, while secondary measures included antiemetic medication consumption and changes in blood glucose levels between the groups.

STATISTICAL ANALYSIS

All characteristics were summarised descriptively. For continuous variables, summary statistics such as mean±Standard Deviation (SD) were used. For categorical data, the number and percentage were used for data summaries and diagrammatic presentation. The Chi-square (χ^2) test was used to assess the association between two categorical variables. If the p-value was less than 0.05, the results were considered statistically significant; otherwise, they were considered not statistically significant. Data were analysed using Statistical Package for Social Sciences (SPSS) software v.23.0 and Microsoft Office 2007.

RESULTS

Among 90 patients included in the study with 45 patients in each group, a comparison of gender and ASA status between Group-D and Group-C showed no statistically significant difference in gender (p=0.259) and ASA status of the participants in both groups (p=0.634) [Table/Fig-3].

Variables	Group-D (n=45)		Group-C (n=45)		Chi-square value	p-value
	n	%	n	%		
Gender					1.272	0.259
Male	17	37.8	12	26.7		
Female	28	62.2	33	73.3		
ASA status					0.227	0.634
ASA 1	32	71.1	34	75.6		
ASA 2	13	28.9	11	24.4		

[Table/Fig-3]: Demographic parameters distribution between study groups.

A comparison of demographic parameters (age, weight, height, BMI) between Group-D and Group-C showed no statistically significant differences (p>0.05) [Table/Fig-4].

Statistically significant differences were observed between Group-D and Group-C for the Bellville score at three hours (p=0.015) and six hours (p=0.044) statistically there were no significant differences between Group-D and Group-C at one hour (p=0.071), 12 hours (p=0.320), and 24 hours (p=0.320) [Table/Fig-5] [12].

Demographic parameters	Group-D (n=45) (mean±SD)	Group-C (n=45) (mean±SD)	p-value
Age (years)	33.73±5.99	33.11±5.23	0.601
Weight (kg)	61.93±7.54	61.65±6.68	0.802
Height (m)	1.63±0.05	1.62±0.06	0.391
BMI (kg/m^2)	23.46±1.76	23.54±1.42	0.806

[Table/Fig-4]: Demographic parameters between Group-D and Group-C.

Duration	Group-D (n=45) Mean±SD	Group-C (n=45) Mean±SD	Mean difference	p-value
1 hour	1.33±0.90	1.73±1.16	-0.40	0.071
3 hour	1.07±0.25	1.40±0.86	-0.33	0.015*
6 hour	1.07±0.33	1.31±0.73	-0.24	0.044*
12 hour	1.00±0.00	1.04±0.30	-0.04	0.320
24 hour	1.00±0.00	1.07±0.45	-0.07	0.320

[Table/Fig-5]: Postoperative nausea vomiting on Bellville score between study groups [12].
Note: *significant at 5% level of significance (p<0.05)

A comparison of clinical parameters between Group-D and Group-C showed no significant difference in blood sugar levels before the study fluid infusion between the two groups [Table/Fig-6]. However, there was a significant difference between Group-D and Group-C for the overall PONV scale, overall incidence of PONV, and the need for rescue antiemetic medication (p<0.05).

Parameters		Group-D Mean±SD	Group-C Mean±SD	Mean difference	p-value
Overall PONV Scale		1.1±0.2	1.3±0.3	-0.22	<0.001*
Comparison of blood sugar level (in mg/dL)	T1	109.91±19.38	114.22±12.30	-4.31	0.211
	T2	155.91±19.90	103.33±9.55	52.58	<0.001*

Parameters	Group-D (n=45) N	Group-D (n=45) %	Group-C (n=45) N	Group-C (n=45) %	Chi-square value	
Overall incidence of PONV	11	24.4%	36	80.0%		<0.001*
Need of rescue antiemetic	4	8.9%	15	33.3%	8.073	0.004*

[Table/Fig-6]: Clinical parameters between Group-D and Group-C.
Note: *significant at 5% level of significance (p<0.05), T1 (baseline blood sugar) mg/dL, T2 (Blood sugar after study drug infusion) mg/dL

DISCUSSION

The PONV is one of the leading causes of unanticipated hospital admissions and a limiting factor in the early discharge of surgical patients. Laparoscopic surgeries have a higher incidence of PONV compared to other surgical procedures, with an incidence of approximately 60 to 70% [6]. Laparoscopic cholecystectomy is a standard surgical approach for cholelithiasis. The incidence of PONV is generally higher in laparoscopic surgeries [13]. Despite numerous medications being used for PONV, they are often associated with side effects like hypotension, dysphoria, excessive sedation, hallucination, and dry mouth [14]. Although there is inconclusive evidence regarding the efficacy of perioperative glucose administration on PONV, oral and intravenous carbohydrate-rich liquids have been widely used for the treatment of PONV with good results [15].

The present study evaluated the effect of prophylactic administration of 500 mL of 5% dextrose given half an hour before the end of surgery on PONV in patients undergoing elective laparoscopic cholecystectomy. The study showed that patients who received 5% dextrose had a lower incidence of nausea and vomiting (24.4%) compared to the control group (80%). Additionally, the intensity of PONV, as graded on the Bellville scale, was slightly lower in patients receiving 5% dextrose for up to six hours postoperatively. Patients in the study group also had lower Bellville scores at 3 to 6 hours compared to patients in the control group. The requirement for rescue antiemetics was less in the study group (9%) compared to the control group (33%) [12].

Atashkhoei et al., studied the intraoperative use of 5% dextrose similar to the present study but in patients undergoing diagnostic gynaecologic laparoscopy surgery [16]. They found a significant decrease in the incidence of PONV in the dextrose group compared to the control group (22.85% vs. 45.7%), as well as a reduction in the severity of PONV, delay in the first time to request an antiemetic after surgery, and reduced total dose of antiemetic drugs used. These results are similar to the current study. Firouzian et al., studied the effect of dextrose infusion on PONV in laparoscopic cholecystectomy and found a statistically significant difference in nausea vomiting scores between both groups (p<0.05). They also observed a low negative correlation coefficient between blood glucose levels and nausea scores upon Postanaesthetic Care Unit (PACU) arrival [11]. Dextrose administration reduced the odds of vomiting events compared to placebo (estimate: -0.87, odds ratio=0.42, 95% confidence interval: 0.28-0.64). The present study is similar to the present study, although they did not specifically study the incidence of PONV [16].

These study findings are also supported by other studies conducted by Dabu-Bondoc et al., and Irkal et al., who studied intravenous dextrose administration in gynaecologic laparoscopic, hysteroscopic surgeries, and endoscopic middle ear surgeries [17,18]. Dabu-Bondoc concluded that postanaesthesia intravenous dextrose administration did not result in significantly different postoperative nausea scores compared to the control group (p>0.05); however, patients who received dextrose consumed fewer rescue antiemetic medications (p=0.02) and had a shorter length of stay in the PACU (p=0.03) compared to patients in the control group. Irkal et al., observed that PONV scores were nearly the same between both groups and were not statistically significant (p>0.05). The dextrose group received fewer antiemetics (p=0.004) and had a shorter duration of stay in the postanaesthesia care unit (p<0.0001) [17,18].

Sada S et al., showed that oral administration of carbohydrate-rich liquid drinks improved overall well-being, like thirst, hunger, mouth dryness, nausea, and weakness, in patients undergoing open cholecystectomy (p<0.05). However, there were no significant differences in postoperative nausea scores or lengths of hospital stay between the groups (p<0.05) [19]. Rao V et al., conducted a separate study confirming the benefit of administering dextrose in laparoscopic surgeries [20].

Three meta-analyses have examined the efficacy of perioperative intravenous dextrose administration as prophylaxis for PONV. One of these, conducted by Yokoyama C et al., concluded that dextrose administration may decrease the incidence of nausea [21].

Indeed, several other studies have identified dehydration as a factor for a higher incidence of PONV, and adequate fluid replacement has been shown to improve PONV [5,6,9,10]. Lambert KG et al., noted that a preoperative fluid bolus using the 4-2-1 rule significantly decreases the incidence of PONV [22].

Dextrose is presumed to act as an antiemetic due to its high osmotic pressure, which reduces muscle contractions in the gastrointestinal tract. It also decreases gastric acid secretion, resulting in decreased gastric muscle contraction by inhibiting the vagal cholinergic pathways [16]. Prolonged fasting is known to cause gastric mucosal hypoperfusion, which is further worsened by general anaesthesia and pneumoperitoneum, leading to increased intra-abdominal pressure. Adequate hydration with carbohydrate-rich fluids reduces mucosal hypoperfusion and reduces PONV [5,6,16].

Contrary to our findings, Zorrilla-Vaca A et al., Patel P et al., and Kim SH et al., [8,10,23] reported different results. Zorrilla-Vaca A et al., in a meta-analysis, concluded that perioperative dextrose

infusion was not significantly associated with a reduction in PONV in the postanaesthesia care unit (risk ratio=0.91, 95% CI, 0.73-1.15; p=0.44). Patel P et al., in a randomised controlled trial, found no significant difference in PONV between groups during the first two hours of the postoperative period (Group-D 52.9% vs. Group-P 46.7%, p=0.43). Both groups had similar scores for nausea and vomiting severity during the postoperative stay and required more than one dose of antiemetic medication. However, Kim SH et al., studied the effect of 10% dextrose infusion on PONV in laparoscopic surgeries and concluded that there was a decrease in the requirement for antiemetics in the dextrose group [23].

Differences in the pathogenesis of nausea and vomiting may explain the discrepancy in results between different studies [21]. The present study was conducted in laparoscopic cholecystectomy, while other published studies were conducted in gynaecological surgeries, middle ear surgeries, etc., [11,18]. In the current study, Ringer's lactate solution was used for the preparation of the study fluid, while other studies have used normal saline for the same purpose [5,9]. Additionally, in the present study, the fluid was administered 30 minutes before the end of surgery, whereas some other studies administered the study fluid postoperatively [18,20]. Thus, although the studies showed a trend of decreased use of antiemetics in patients receiving dextrose, the magnitude of this effect may differ among the studies. The need for rescue antiemetic drugs depends on the baseline emesis risk of the included samples and whether any PONV prophylaxis was used [24].

Patients who received 5% dextrose had slightly higher blood sugar levels postoperatively (155.9±19.9 mg/dL) compared to the control group (103.3±9.3 mg/dL), which is within a clinically acceptable range. In the present study, the blood sugar level was measured before and after study infusion in both groups. When comparing the two groups, the mean difference was higher after study infusion in those receiving dextrose but did not exceed 200 mg/dL. Patients with perioperative hyperglycaemia are at a high-risk of developing complications such as dehydration, electrolyte disturbances, fluid shifts, ketoacidosis, hyperosmolar states, and increased mortality and length of hospital stay during the postoperative period [11]. In line with this, the present study found higher blood sugar levels in patients who received dextrose, but it did not exceed 200 mg/dL. Rao V et al., and Firouzian A et al., also reported higher blood sugar levels in the study group [11,20]. It is generally recommended to keep blood sugar levels between 140 to 200 mg/dL in patients with or without diabetes [25]. Consistent with the findings of the present study and several other studies, the judicious use of intravenous dextrose-containing fluids is safe and effective in non diabetic patients in reducing postoperative side effects like nausea, vomiting, and dehydration without significantly increasing blood sugar levels [7,11,16].

Limitation(s)

The study had several limitations. Firstly, confounding factors such as the use of nitrous oxide and opioids were not studied, which could have influenced the incidence of PONV. Secondly, the study was conducted only in patients undergoing laparoscopic cholecystectomy, and other types of laparoscopic surgeries were not included. Therefore, the results may not be generalisable to other surgical procedures. Additionally, the duration or length of the surgery was not taken into consideration when analysing the parameters, which could have potentially affected the incidence of PONV.

CONCLUSION(S)

A 500 mL infusion of 5% dextrose given half an hour before the end of surgery reduces the incidence of PONV in patients undergoing laparoscopic cholecystectomy under general anaesthesia. It also reduces the need for rescue antiemetics in the postoperative period. In terms of blood sugar levels, there was a significant difference after the infusion of the drug between the two groups. Therefore, the regular use of a 500 mL infusion of 5% dextrose can be recommended in laparoscopic cholecystectomy for its beneficial effect on PONV.

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