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The Effectiveness of Citro Soda Solution for Relief of Epigastric Discomfort and Dyspepsia in the Intraoperative Period During Elective Cesarean Section Under Spinal Anesthesia: A Randomized Controlled Trial

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ABSTRACT

Objectives: This study aimed to evaluate the effectiveness of Citro Soda solution in relieving intraoperative dyspepsia among patients undergoing elective cesarean sections (LSCS) under spinal anesthesia. **Study Settings:** The study was conducted in the Department of Anesthesia at Holy Family Hospital over a six-month period following approval from the institutional ethics committee. **Duration of Study:** Six months from 16 July 2024 to 15 January 2025. **Methodology:** This randomized controlled trial (RCT) included 60 patients, randomly assigned to receive either Citro Soda (n=30) or placebo (n=30) one hour prior to spinal anesthesia. Inclusion criteria comprised women aged 18–55 years undergoing elective cesarean section with subjective dyspepsia in their third trimester. Patients with chronic gastritis, gastrointestinal disease, or major comorbidities were excluded. The primary outcome was subjective relief of dyspeptic symptoms, assessed intraoperatively. Surgical duration and pain relief scores were also compared between the two groups. **Results:** The mean surgical duration was 62.24 minutes (±16.88) in the Citro Soda group and 60.13 minutes (±16.27) in the placebo group ($p = 0.623$). The mean pain relief score was 1.20 (±0.41) in the Citro Soda group compared to 1.37 (±0.49) in the placebo group ($p = 0.157$). **Conclusion:** Citro Soda did not significantly reduce intraoperative dyspepsia during cesarean section under spinal anesthesia. While it remains an effective gastric acid neutralizer, it does not appear to provide meaningful symptomatic relief.

INTRODUCTION

Lower segment cesarean section (LSCS) is one of the most common obstetric procedures performed globally.[1-5] It is primarily conducted under regional anesthesia, with spinal anesthesia (SA) being the most commonly utilized technique for LSCS.[6-8] Spinal anesthesia is preferred by anesthesiologists for women undergoing cesarean section (C-section) as it eliminates the need for endotracheal intubation, which can be challenging in obstetric patients, and reduces the risk of aspiration. Moreover, it provides effective pain control and allows for early recovery and return to routine activities.[9]

Many women undergoing C-section under spinal anesthesia experience dull epigastric pain, often accompanied by nausea, vomiting, or hypotension. Multiple mechanisms have been proposed in the literature to explain this discomfort. One of the primary reasons for dyspepsia during C-section under spinal anesthesia is gastric acid reflux, which can lead to significant epigastric discomfort and, in severe cases, aspiration of gastric contents. Since patients under spinal anesthesia are not intubated, they remain at risk of aspiration. The aspiration of gastric acid can cause epigastric burning and severe complications such as aspiration pneumonia.[10]

Several studies have demonstrated that 50-65% of patients undergoing cesarean section under spinal anesthesia experience epigastric discomfort. If gastric reflux occurs, it can lead to further complications such as aspiration pneumonia.[11] Preoperative fasting for 6-8 hours has significantly reduced the incidence of aspiration pneumonia in elective surgeries.[12] However, in cesarean sections, the risk of aspiration pneumonia remains higher due to increased intra-abdominal pressure during pregnancy. While aspiration pneumonia has been reported in less than 1% of elective surgeries, the risk during C-section is nearly threefold higher due to gastric reflux.[12]

Proton pump inhibitors (PPIs) and other acid-suppressing agents are commonly used prophylactically to reduce gastric acidity. Studies indicate that nearly 50% of obstetric patients experiencing dyspepsia due to gastroesophageal reflux disease (GERD) find relief with the use of antacid solutions prior to surgery.[13] A recent meta-analysis on the effectiveness of various dyspepsia treatments suggests that sodium bicarbonate-containing Citro Soda solution effectively reduces gastric discomfort by increasing gastric pH and, consequently, lowering the risk of aspiration pneumonia.[14] A study conducted in Moscow reported that sodium bicarbonate-based antacid solutions improved dyspepsia in 79% of patients,[15] whereas the use of placebo agents (such as distilled water) resulted in only 44% symptom relief.[16]

LSCS remains a widely performed obstetric procedure, with spinal anesthesia as the predominant anesthetic technique. Citro Soda solution (sachets/syrup) is a cost-effective and readily available antacid that can be used preoperatively to neutralize gastric acid and alleviate epigastric discomfort. Given its accessibility and potential benefits, this study aims to determine the effectiveness of Citro Soda solution in reducing intraoperative epigastric discomfort and dyspepsia during cesarean sections performed under spinal anesthesia.

METHODOLOGY

This study was designed as a randomized controlled trial (RCT) to assess the effectiveness of Citro Soda solution compared to placebo in relieving dyspepsia during the intraoperative period of elective cesarean section under spinal anesthesia. The study was conducted in the Department of Anesthesia at Holy Family Hospital over a duration of six months following approval of the research synopsis.

The sample size was calculated using the WHO sample size calculator for RCTs, considering a 79% frequency of dyspepsia relief with Citro Soda and a 44% frequency with placebo, with a 5% level of significance and 80% power of the test. Based on these parameters, a total of 60 patients were recruited, with 30 patients allocated to each group (Citro Soda and Placebo). We used consecutive non-probability sampling technique while selecting the patients.

All eligible cases were those between 18 and 55 years, selected for elective cesarean section under spinal anesthesia, and experiencing subjective dyspepsia in their third trimester of gestation. Patients with biopsy-proven chronic gastritis, chronic liver disease, adenocarcinoma, or comorbidities such as hypertension, diabetes mellitus, or ischemic heart disease were excluded. Additionally, those having a history of previous gastric surgery or anti-reflux procedures were excluded from this trial.

Ethical approval letter was obtained from ethical Review Board of the institute prior to enrollment of the patients, whereas routine written informed consent was also taken from all the subjects. Randomization was performed assigning to either the Citro Soda group or the placebo group with the help of lottery method. The Citro Soda group received one sachet of Citro Soda (1209 mg per 5 mL) mixed in water, administered one hour prior to spinal anesthesia. The placebo group received 5 mL of distilled water at the same time interval. The effectiveness of the intervention was evaluated based on subjective reports of relief from epigastric discomfort during the intraoperative period.

A structured proforma was used for data collection, including patient age, duration of surgery, history of prior surgery, and subjective improvement in dyspepsia. All data were systematically recorded and analyzed using SPSS version 23.0. Quantitative variables such as age and duration of surgery were presented as mean ± standard deviation (SD), whereas qualitative variables, including history of prior surgery and subjective dyspepsia relief, were presented as frequencies and percentages. We used chi-square test for comparison of proportion of patients in both groups.

RESULTS

The table presents the frequency distribution of age and history of prior surgery among the study participants. The age distribution shows that 39 patients (65.0%) were between 18 and 40 years old, whereas 21 patients (35.0%) were older than 40 years. This indicates that the majority of participants were younger than 40 years. Regarding the history of prior surgery, 20 patients (33.3%) had previously undergone a surgical procedure, whereas 40 patients (66.7%) had no prior history of surgery. The majority of participants did not have a surgical history, suggesting that a significant proportion of patients undergoing elective cesarean section under spinal anesthesia were experiencing surgery for the first time (Table & Fig. 1).

For Duration of Surgery, the mean duration in the Citro Soda group was 62.24 minutes (±16.88), whereas in the Placebo group, it was 60.13 minutes (±16.27). The p-value for this comparison was 0.623, which is greater than 0.05, indicating that the difference in duration of surgery between the two groups was not statistically significant. This suggests that the administration of Citro Soda did not have a meaningful impact on the duration of the procedure. For Pain Relief, the mean score in the Citro Soda group was 1.20 (±0.41), while in the Placebo group, it was 1.37 (±0.49). The p-value for this comparison was 0.157, which is also greater than 0.05, showing that there was no statistically significant difference in pain relief between the two groups. While the Citro Soda group had a lower mean pain score, this

difference may have been due to chance rather than a true effect of the intervention.(Table 2)

Table 3 presents the statistical comparison of Duration of Surgery and Pain Relief between the Citro Soda and Placebo groups, categorized according to different effect modifiers, using the Independent Samples Test. The table evaluates two primary factors: Age and History of Prior Surgery, analyzing their impact on surgical duration and pain relief outcomes. For patients aged 18 to 40 years, the mean duration of surgery was 61.92 ± 18.54 minutes in the Citro Soda group and 59.24 ± 16.61 minutes in the Placebo group. The statistical analysis revealed a p-value of 0.636, indicating no significant difference in surgical duration between the two groups. Similarly, the mean pain relief score in this age category was 1.16 ± 0.37 for Citro Soda and 1.35 ± 0.49 for Placebo, with a p-value of 0.179, suggesting no statistically significant difference in pain relief outcomes.

For patients aged above 40 years, the mean duration of surgery was 62.80 ± 14.40 minutes in the Citro Soda group compared to 61.91 ± 16.27 minutes in the Placebo group (p = 0.895), again showing no statistically significant difference. Likewise, the pain relief scores for this age group were 1.27 ± 0.47 for Citro Soda and 1.40 ± 0.52 for Placebo, with a p-value of 0.560, indicating no significant difference in pain relief between the two treatment groups. Among patients with a history of prior surgery, the mean duration of surgery was 63.18 ± 19.30 minutes in the Citro Soda group and 61.16 ± 13.53 minutes in the Placebo group, with a p-value of 0.820, suggesting no significant difference. Regarding pain relief, the mean score was 1.21 ± 0.43 for Citro Soda and 1.33 ± 0.52 for Placebo, with a p-value of 0.597, indicating no statistically significant variation between the groups.

For patients without a history of prior surgery, the mean duration of surgery was 61.42 ± 15.05 minutes in the Citro Soda group and 59.87 ± 17.14 minutes in the Placebo group (p = 0.770), showing no notable difference. In terms of pain relief, the Citro Soda group had a mean score of 1.19 ± 0.40, whereas the Placebo group had a mean score of 1.38 ± 0.49, with a p-value of 0.215, indicating no significant difference in pain relief.

Table 1

Frequency Distribution of Age and History of Prior Surgery in patients undergoing cesarean section(n=60)

Variable	Category	Frequency	Percent
Age	18-40	39	65.0%
	>40	21	35.0%
	Total	60	100.0%
History of Prior Surgery	Yes	20	33.3%
	No	40	66.7%
	Total	60	100.0%

Figure 1

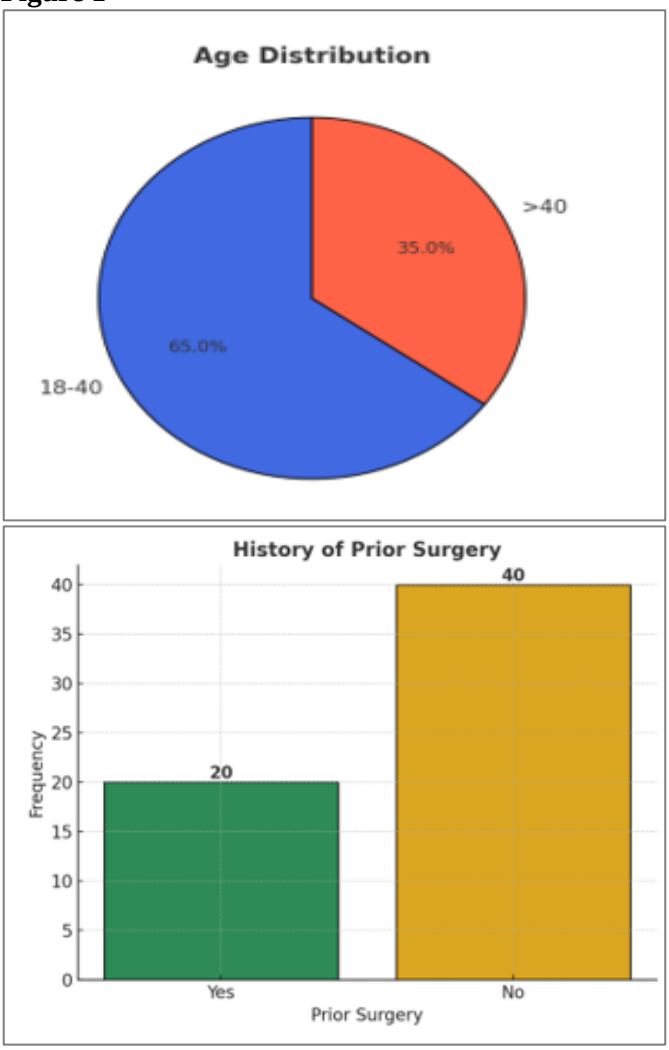

Table 2

Statistical comparison of Duration of Surgery and Pain Relief Using Independent Samples Test

Variable	Group	N	Mean	Std. Deviation	P value[a]
Duration of Surgery	Citro Soda	30	62.24	16.88	0.623
	Placebo	30	60.13	16.27	
Pain Relief	Citro Soda	30	1.20	0.41	0.157
	Placebo	30	1.37	0.49	

[a] independent t test

Table 3

Statistical comparison of Duration of Surgery and Pain Relief Using Independent Samples Test according to different effect modifiers

Effect modifiers				N	Mean	Std. Deviation	P value
Age(years)	18-40	Duration of Surgery	Citro Soda	19	61.92	18.54	0.636
			Placebo	20	59.24	16.61	

	>40	Pain Relief	Citro Soda	19	1.16	0.37	0.179
			Placebo	20	1.35	0.49	
		Duration of Surgery	Citro Soda	11	62.80	14.40	0.895
			Placebo	10	61.91	16.27	
		Pain Relief	Citro Soda	11	1.27	0.47	0.560
			Placebo	10	1.40	0.52	
History of prior surgery	Yes	Duration of Surgery	Citro Soda	14	63.18	19.30	0.820
			Placebo	6	61.16	13.53	
		Pain Relief	Citro Soda	14	1.21	0.43	0.597
			Placebo	6	1.33	0.52	
	No	Duration of Surgery	Citro Soda	16	61.42	15.05	0.770
			Placebo	24	59.87	17.14	
		Pain Relief	Citro Soda	16	1.19	0.40	0.215
			Placebo	24	1.38	0.49	

DISCUSSION

The current study aimed to evaluate the effectiveness of Citro Soda solution in relieving dyspepsia during elective cesarean sections (LSCS) under spinal anesthesia. Our findings indicate that Citro Soda did not significantly impact intraoperative dyspeptic symptoms when compared to the placebo group, as evidenced by the non-significant differences in pain relief scores and surgical duration. Despite its widespread availability and acid-neutralizing properties, Citro Soda did not demonstrate a clinically meaningful benefit in this setting.

Our study included a total of 60 patients, of whom 39 (65.0%) were aged 18–40 years, while 21 (35.0%) were older than 40 years. Additionally, 20 patients (33.3%) had undergone previous surgery, while 40 patients (66.7%) were undergoing surgery for the first time. This distribution suggests that the majority of participants were younger women undergoing their first cesarean section.

Regarding surgical duration, the mean duration of surgery in the Citro Soda group was 62.24 minutes (±16.88), compared to 60.13 minutes (±16.27) in the placebo group. The p-value of 0.623 indicated that this difference was not statistically significant, suggesting that Citro Soda administration did not influence the duration of surgery. Similarly, pain relief scores were 1.20 (±0.41) in the Citro Soda group and 1.37 (±0.49) in the placebo group. The p-value of 0.157 demonstrated that this difference was also not statistically significant, implying that Citro Soda did not provide significant relief from epigastric discomfort during the procedure.

When stratified by age and prior surgical history, further analysis revealed no significant differences in surgical duration or pain relief scores across subgroups. For patients aged 18–40 years, the mean duration of surgery was 61.92 ± 18.54 minutes in the Citro Soda group and 59.24 ± 16.61 minutes in the placebo group (p = 0.636). Similarly, pain relief scores in this age category were 1.16 ± 0.37 (Citro Soda) vs. 1.35 ± 0.49 (Placebo, p = 0.179). Among patients older than 40 years, surgery duration was 62.80 ± 14.40 minutes (Citro Soda) vs. 61.91 ± 16.27 minutes (Placebo, p = 0.895), while pain relief scores were 1.27 ± 0.47 vs. 1.40 ± 0.52 (p = 0.560).

A similar trend was observed when comparing patients based on history of prior surgery. Among those with previous surgical history, the mean duration of surgery was 63.18 ± 19.30 minutes in the Citro Soda group vs. 61.16 ± 13.53 minutes in the placebo group (p = 0.820). Pain relief scores were 1.21 ± 0.43 (Citro Soda) vs. 1.33 ± 0.52 (Placebo, p = 0.597). For patients undergoing their first surgery, the mean duration was 61.42 ± 15.05 minutes in the Citro Soda group vs. 59.87 ± 17.14 minutes in the placebo group (p = 0.770), with pain relief scores of 1.19 ± 0.40 vs. 1.38 ± 0.49 (p = 0.215). These findings reinforce the conclusion that Citro Soda did not significantly improve intraoperative dyspeptic symptoms or surgical outcomes.

The role of sodium citrate-based antacids in obstetric anesthesia has been explored in prior studies. Lim et al. (1991)[17] demonstrated that sodium citrate significantly increased gastric pH in obstetric patients undergoing cesarean section, thereby reducing the risk of acid aspiration syndrome. However, our study did not measure gastric pH, focusing instead on subjective dyspepsia relief. The lack of significant symptom relief in our cohort raises concerns about the clinical effectiveness of Citro Soda for symptomatic dyspepsia rather than acid neutralization.

The Cochrane review by Gyte & Richens (2006)[18] evaluated the routine prophylactic administration of antacids in laboring women and found limited evidence supporting their effectiveness in preventing gastric aspiration. These findings align with our results, suggesting that while Citro Soda may neutralize gastric acid, it does not necessarily translate into better symptom control or comfort for patients undergoing LSCS under spinal anesthesia.

Recent pharmacological studies suggest that proton pump inhibitors (PPIs) and neuromodulators may offer better relief for functional dyspepsia. Kotikula et al (2021)[19] found that pregabalin significantly improved dyspepsia symptoms in patients who were non-responsive to PPIs, suggesting a potential alternative approach. While PPIs and H2 receptor antagonists are

widely used preoperatively to reduce gastric acidity, there is no strong evidence supporting their routine use in elective cesarean sections, as indicated by the Cochrane review.

The modern approach to dyspepsia management, as described by Barbara Medić et al,[20] emphasizes the role of gastric motility agents and neuromodulators rather than simple acid neutralization. This suggests that Citro Soda, despite its immediate acid-neutralizing effect, may not sufficiently address underlying dyspeptic symptoms, particularly in the context of pregnancy-related reflux and intra-abdominal pressure changes.

Gastric dyspepsia during cesarean section under spinal anesthesia is likely multifactorial. Increased intra-abdominal pressure, reduced gastric emptying, and hormonal influences of pregnancy contribute to gastroesophageal reflux and epigastric discomfort. While Citro Soda contains sodium bicarbonate, which neutralizes acid, it does not affect gastric emptying or lower esophageal sphincter tone, which may explain its lack of significant symptomatic benefit in our study.

Our findings, suggesting that single-dose Citro Soda alone is insufficient for managing intraoperative dyspepsia.

Although Citro Soda is an accessible and well-tolerated antacid, our study suggests it may not provide meaningful symptomatic relief during cesarean section under spinal anesthesia. Future studies should explore:

1. Prokinetic agents (e.g., domperidone, metoclopramide) for enhancing gastric emptying.
2. Alternative acid suppression therapies such as H2 receptor blockers or PPIs.
3. Combination approaches, integrating Citro Soda with prokinetics or neuromodulators to optimize symptom control.

A larger randomized controlled trial with gastric pH monitoring, reflux severity assessment, and symptom tracking could provide a more comprehensive evaluation of Citro Soda's efficacy.

CONCLUSION

Citro Soda did not significantly reduce intraoperative dyspepsia during cesarean section under spinal anesthesia. While it remains an effective gastric acid neutralizer, it does not appear to provide meaningful symptomatic relief. Given the multifactorial nature of intraoperative dyspepsia, future studies should explore alternative therapies such as prokinetics, proton pump inhibitors, or neuromodulators to enhance symptom control during cesarean delivery.

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