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ORIGINAL CONTRIBUTIONS

Prospective Assessment of Postoperative Nausea Early After Bariatric Surgery

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Abstract

Background The most common reason for readmission after bariatric surgery is postoperative nausea and vomiting (PONV). The aim of this study was to compare the incidence and severity of PONV between patients undergoing laparoscopic sleeve gastrectomy (SG) and gastric bypass (GB).

Methods This was a prospective observational cohort study that evaluated all patients who underwent non-revisional isolated SG or GB at a tertiary care center. Patients were asked to grade their nausea on a 10-point Likert scale at 2 h postoperatively and the morning of each postoperative day (POD).

Results There were 65 patients that matched the inclusion criteria, of which 29 underwent SG and 36 underwent GB. There were no significant differences in age ($p = 0.198$), BMI ($p = 0.294$), American Society of Anesthesiology classification ($p = 0.380$), or male gender ($p = 0.164$) when comparing SG and GB patients. Perioperative PONV prophylaxis was similar. There were no differences in LOS (2.6 ± 1.3 vs 2.3 ± 0.5 days, $p = 0.919$) or readmission/visit to the emergency department due to PONV (10.3% vs 13.9%, $p = 0.665$) between the two groups. Prolonged LOS due to PONV occurred in 20.7% of SG patients and 19.4% of GB patients ($p = 0.901$).

Conclusions The severity and incidence of PONV are similar following SG and GB. Importantly, there was no difference in hospital utilization due to PONV between SG and GB.

Keywords Postoperative nausea · Vomiting · Bariatric surgery · Sleeve gastrectomy · Gastric bypass

Background

Bariatric surgery is commonly performed in the USA and is proven to be the most effective treatment for severe obesity and its associated comorbidities. While laparoscopic sleeve gastrectomy (SG) and gastric bypass (GB), the most commonly performed bariatric procedures, are associated with minimal postoperative morbidity, hospital readmissions occur and are costly [1]. Additionally, readmissions represent a quality metric for both hospitals and providers. The most common reason for readmission following bariatric surgery is postoperative nausea or vomiting (PONV) and the associated sequelae of dehydration [2–5].

PONV is of particular importance to bariatric surgery practice, as anticipatory early postoperative changes may already impair patients' ability to maintain adequate oral intake and stay hydrated. There is limited data on PONV with respect to bariatric patients. Although previous studies have attempted to evaluate the incidence of PONV in this patient population, the clinical effect of PONV on hospital resource utilization remains unclear. Furthermore, there are no direct comparisons between SG and GB, with regard to PONV. The aim of this study was to quantify PONV in patients undergoing bariatric surgery, assess the effect of PONV on hospital resource utilization, and compare both the incidence and severity of PONV between patients undergoing SG and GB.

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Methods

This was a prospective, observational cohort study that examined all patients undergoing SG or GB in a single academic tertiary care practice over a 12-month period (July 2015–June 2016). The inclusion criteria included patients aged 18 years or older undergoing primary laparoscopic SG or GB. Patients who underwent any concomitant operations including cholecystectomy and incisional hernia or hiatal hernia repair, based either on preoperative planning or on intraoperatively diagnosed pathology, were excluded. We also excluded patients with allergies to antiemetic medications, history of previous gastric or esophageal surgery, pre-existing chronic nausea or emesis, or chronic opioid use. Informed consent was obtained from all participants.

All SG procedures were performed using sizing a 40 Fr bougie and antral division started at 5 cm from the pylorus. The antecolic antegastric approach was used for GB procedures. The gastrojejunal anastomosis GB was performed with a 25-mm circular stapler, or using the linear stapler at 30-mm length and closing the common enterotomy with a running two-layer suture. All patients underwent anesthesia with inhalation anesthetics and opioids. Intraoperative antiemetic use was driven by the anesthesiology team. Postoperative PONV management included as needed intravenous medications (ondansetron 4 mg and promethazine 12.5 mg) every 6 h; for patients with persistent PONV, second-line medications were used (scopolamine patch as first choice, followed by metoclopramide).

The subjects were assessed at four different time points for a PONV-specific evaluation: 2 h postoperatively, the morning of postoperative day (POD) 1, the morning of POD 2, and at their postoperative clinic visit (approximately POD 14) (Table 1). Additional information collected included age, gender, body mass index (BMI), American Society of Anesthesia (ASA) class, history of established risk factors for PONV, need for pain and antiemetic medications, length of stay, delay in discharge related to PONV, and readmission within 30 days. All patients were required to be nicotine and tobacco free for at least 3 months prior to surgery. The past history of tobacco use was recorded and analyzed. The clinical pathway for bariatric surgery patients during this study included initiation of oral intake on POD 1 and anticipated target hospital discharge on POD 2. Hospital discharge after POD 2 was considered delayed. This study was approved by the Institutional Review Board. Nominal variables were compared using chi-squared test. Continuous variables were compared using Student's *t* test. Results are reported as frequency for nominal variables and mean (± standard deviation) for continuous variables. Any p value < 0.05 was considered statistically significant. SPSS (IBM, Somers, NY) version 22 was used for data analysis.

Results

Sixty-five patients who agreed to participate in the study did not undergo a concomitant procedure at the time of bariatric surgery and comprised the study population. This included 29 SG patients and 36 GB patients. There were no significant differences in age (46.5 ± 9.7 vs 43.1 ± 12.5 years, $p = 0.198$), BMI (46.9 ± 6.1 vs 50.5 ± 10.1 kg/m^2, $p = 0.294$), ASA classification (2.8 ± 0.4 vs 2.7 ± 0.5, $p = 0.380$), male gender (24.1% vs 11.1%, $p = 0.164$), history of tobacco use (34.5% vs 33.3%, $p = 0.922$), and previous diagnosis of PONV (10.3% vs 13.9%, $p = 0.665$) between SG and GB patients, respectively. Operative time was shorter for the SG group (74.3 ± 20.2 vs 119.2 ± 52.1 min, $p = 0.003$).

There was no difference in the number of prophylactic PONV medications given intraoperatively (1.7 ± 0.8 vs 1.7 ± 0.8, $p = 0.768$). Scopolamine patch was used in 24.1% of SG and 25.7% of GB patients ($p = 0.885$) and dexamethasone was administered in 37.9% of SG and 37.1% of GB patients ($p = 0.948$). Anesthesia management was similar between the two groups: sevoflurane was used for maintenance of general anesthesia in 75% of SG and 55% of GB patients ($p = 0.089$), while the remainder of the cohort received desflurane.

Table 1 Questions provided to the subjects during each assessment

Question	Response
"Have you experienced a feeling of nausea?"	Yes/No
"Has your nausea interfered with activities of daily living?"	Not at all/Sometimes/Often/All the time
"Rate your nausea from a scale of 0 to 10, with 0 being no nausea and 10 being the worst possible"	0–10
"Would you describe your nausea as mild, moderate or severe?"	Mild/Moderate/Severe
"Did you have any dry retching since surgery?"	Yes/No
"Did you have any vomiting since surgery?"	Yes/No
"How many times have you vomited or had dry-retching?"	None/Once/Twice/Three or more times

The incidence of PONV during the hospital stay was 89.2% of the entire cohort: 69.2% at 2 h, 64.6% on POD1, and 56.9% on POD2. Comparisons in PONV severity, opioid use, and need for rescue antiemetics are reported in Table 2. There were no differences in LOS (2.6 ± 1.3 vs 2.3 ± 0.5, p = 0.919), ED visit (3.4% vs 11.1%, p = 0.249), or readmission (4.2% vs 12.1%, p = 0.275) between the SG and GB groups. Prolonged LOS due to PONV occurred in 20.7% of SG patients and 19.4% of GB patients (p = 0.901). Patients with a history of tobacco use (n = 22) had lower rate of prolonged LOS due to PONV (13.6% vs 23.3%, p = 0.359) but this difference was not statistically significant. Hospital readmissions or ED visits for PONV were observed in 12.3% (8 occurrences) of patients; 10.3% after SG and 13.9% after GB (p = 0.665). After controlling for number of prophylactic antiemetics used, there was still no independent effect of procedure type on prolonged PONV-related LOS (OR for SG 2.02, 95% CI 0.43–9.42) or PONV-related readmission or ED visit (OR for SG 2.90, 95% CI 0.63–13.25). No additional patient in this study population received outpatient intravenous fluid infusion for PONV or dehydration.

Postoperative clinic follow-up occurred at similar time interval after surgery for each procedure (13.6 ± 2.1 vs 14.1 ± 2.1 days, p = 0.221). During the interval from hospital discharge to postoperative clinic follow-up, there were no differences in the incidence of antiemetic medication use (17.2% vs 16.7%, p = 0.951) or PONV score (0.6 ± 1.2 vs 1.1 ± 2.1, p = 0.502).

Table 2 Patient reported nausea score from Likert scale (0–10), doses of antiemetic medications used, and morphine equivalents of opioids used at 2 h postoperative and the morning of postoperative days (POD) 1 and 2. Impact of PONV on ADL was assessed during the entire hospital stay. *ADL*, activities of daily living; *PONV*, postoperative nausea and emesis; *SG*, sleeve gastrectomy; *GB*, gastric bypass

Endpoint	GB (n = 36)	SG (n = 29)	p value
Opioid use			
2 h	11.9 +/- 7.8	11.7 +/- 6.9	0.564
POD 1	34.6 +/- 26	33.1 +/- 19.8	0.89
POD 2	15.7 +/- 9.1	15.8 +/- 16.1	0.383
Rescue antiemetic dosages used			
2 h	0.7 +/- 0.8	0.7 +/- 0.9	0.794
POD 1	1.6 +/- 1.8	2.7 +/- 2.3	0.056
POD 2	2.1 +/- 2.3	3.3 +/- 2.7	0.063
Severity of nausea			
2 h	3.7 +/- 3.4	3.7 +/- 3.5	0.962
POD 1	2.7 +/- 2.9	3.2 +/- 3	0.383
POD 2	2.6 +/- 3	2.6 +/- 3.1	0.701
Outpatient	1.1 +/- 2.1	0.6 +/- 1.2	0.502
Incidence of nausea			
2 h	24 (66.7%)	21 (72.4%)	0.618
POD 1	27 (75%)	22 (75.9%)	0.936
POD 2	22 (61.1%)	17 (58.6%)	0.839
Total hospital	33 (91.7%)	26 (89.7%)	1.0
Outpatient	9 (25%)	7 (24.1%)	0.215
Incidence of emesis			
2 h	0	1 (3.4%)	0.446
POD 1	1 (2.8%)	3 (10.3%)	0.316
POD 2	1 (2.8%)	4 (13.8%)	0.164
Total hospital	1 (2.8%)	5 (17.2%)	0.081
Outpatient	0	1 (3.4%)	0.446
Incidence of retching			
2 h	4 (11.1%)	7 (24.1%)	0.196
POD 1	8 (22.2%)	8 (27.6%)	0.618
POD 2	3 (8.3%)	7 (24.1%)	0.096
Total hospital	10 (27.8%)	11 (37.9)	0.384
Outpatient	4 (11.1%)	2 (6.9%)	0.684
PONV impact on ADL			
Not at all	20 (55.6%)	16 (55.2%)	0.73
Sometimes	13 (36.1%)	10 (34.5%)	
Often	2 (5.6%)	3 (10.3%)	
All the time	1 (2.8%)	0	

Discussion

The incidence of PONV on hospital readmission following overall bariatric surgery is previously established by us and others [2–5]. Since it represents the most common cause of readmission within 30 days from surgery, the importance in limiting its incidence and severity is paramount. Nevertheless, differences between SG and GB in terms of PONV have not been previously examined in an objective manner. The present study underlines that PONV is equally common following GB and SG. Importantly, hospital resource utilization (length of stay and readmission) related to PONV was similar between the two procedure groups.

Continued PONV after discharge can result in dehydration, for which bariatric patients are already predisposed, given the restrictive nature of the procedure on patients' ability to maintain adequate oral intake. As subsequent readmission is likely and prevalent, for this reason, PONV control is of great concern to this particular patient population.

PONV can be costly to both the patient and our healthcare system, as it frequently leads to inefficient use and overutilization of emergency departments [6, 7]. Chen cites PONV and dehydration as the most common reason for post bariatric surgery ED return visits with a frequency of 17.5%. Further evaluation of these visits revealed that approximately 75% were possibly preventable [6]. Macht et al. report a similar frequency of 20.8% [7]. In the present study, 20% of patients in either procedure group experienced a prolonged hospital

stay due to PONV. This represented a significant interruption in the clinical pathway and recovery for this specific cohort.

Prior studies evaluating PONV in the setting of bariatric surgery have associated higher PONV rate with SG in comparison to GB. A prospective randomized study comparing incidence of PONV in bariatric surgery patients receiving either opioid-free versus traditional mixed narcotic/inhalation anesthesia demonstrated an overall increased incidence of PONV in the SG population (58.6%), regardless of form of anesthesia, versus subjects who underwent gastric banding or GB (19.4%) [8]. PONV severity was measured only once during initial postoperative hospitalization; the true incidence of PONV, therefore, may not be accurately represented. A recent retrospective study evaluating potential 30-day readmissions of subjects in a nationwide quality improvement database who underwent GB or SG reported readmission in 5.1% of the almost 35,000 participating subjects. Readmission was more common following GB procedure; however, PONV and dehydration were more commonly cited reasons for readmission after SG in comparison to GB [5]. Unfortunately, technical considerations for each bariatric procedure were not available and variability is common. With the present study, technical aspects were accounted for and a standard PONV management protocol was applied for both groups, minimizing confounders on the inherent effect of each procedure type on PONV.

This study had several limitations that should be acknowledged, including, the small sample size, the single center design, and the subjective nature of the assessment. The low sample size is a significant limitation of the study. Nevertheless, crude comparisons suggest that delay in discharge was identical between the two groups and readmission rate was higher in the GB patients. Several patients reported difficulty quantifying their nausea, many citing the inability to recall over the past 24 h if nausea was a significant enough issue for them. As self-interpretation of one's state of nausea as well as tolerance is dependent upon each individual patient, the 10-point Likert scale quantifying PONV does not have a standardized interpretation of each number on the scale, and levels of nausea reported may vary significantly. Nevertheless, the primary endpoint of the study was objective and clinically meaningful: the consequence of PONV in terms of delay in discharge and readmission. As the severity of PONV remains unclear, the prolongation of an anticipated 2-day hospital stay due to PONV has real negative implications. Patients undergoing concomitant cholecystectomy and hiatal hernia repair were excluded to eliminate the effect of such procedures on PONV. This significantly impacted the sample size of the study since aggressive hiatal inspection was part of the clinical practice. The clinical pathway in practice at our institution at the time did not include preoperative preventive medications, or many other enhanced recovery steps. It is possible that with such adjuncts, the PONV rate may be overall decreased; however, the clinical pathway was uniform for both SG and GB patients, so our comparative approach and results would remain valid.

In conclusion, PONV is particularly important in bariatric patients as it is a major contributor towards readmission and dehydration. There are no significant differences in PONV between the two most commonly performed weight loss procedures, SG and GB; therefore, protocols and patient education regarding PONV do not need to be procedure specific.

Compliance with Ethical Standards

Conflict of Interest Konstantinos Spaniolas has research support from Merck and in advisory panel for Mallinckrodt. Adam Celio, Lilly Bayouth, and Matthew B. Burruss have no potential conflicts of interest to disclose.

Ethical Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent Statement Informed consent was obtained from all individual participants included in the study.

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