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Is Resection of Greater Portion of Antrum During Sleeve Gastrectomy Linked with Prolonged Duration of Post-Operative/Discharge Nausea and Vomiting?

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Abstract: Although the effectiveness and safety of laparoscopic sleeve gastrectomy (LSG) has been demonstrated, there is still debate over the optimal operative technique, with the resection distance from pylorus (DP) being among the most controversial topics.

3000 sleeve gastrectomy cases were retrospectively studied at our hospital and the number of cases with prolonged post-operative and post discharge nausea and vomiting were set asunder. Most of the cases having nausea and vomiting were of short duration (< 1 week) and were excluded from the study. The cases that met the inclusion criteria were the cases with prolonged duration of nausea and vomiting (several weeks to months) and were 7 in number. These 7 cases were deeply studied and the cause for the prolonged nausea and vomiting was compared with controls (Patients with no prolonged Nausea and vomiting Post-sleeve gastrectomy) and the findings were correlated with the surgery technique used and the resection distance opted. As for the surgical technique and resection distance, out of the 3000 surgeries studied retrospectively, the resection distance from pylorus to antrum used in the first 2200 surgeries was 2-4cm. Later on, after 2200 surgeries, amendments were made to the former operation technique, with a change in resection distance from pylorus to antrum to 4-6cm, after which it was found that the symptoms of nausea and vomiting post sleeve gastrectomy became infrequent and same weight reduction results were obtained. No Incidence of prolonged nausea and vomiting (for weeks or months) was noted at our hospital after adopting the antrum preservation technique when compared to the former technique showing a possible link between antral resection and the development of prolonged nausea and vomiting.

Keywords: Sleeve gastrectomy, Bariatric Surgery, Antral Resection, Antral Preservation Nausea, Vomiting.

Introduction:

Postoperative nausea and vomiting (**PONV**) is the phenomenon of nausea, vomiting, or retching experienced by a patient in the post-anaesthesia care unit (PACU) or within 24 hours following a surgical procedure.

Nausea and vomiting are the most common reasons for hospital readmission following bariatric surgery. Postoperative nausea and vomiting is more likely after LSG than after any other bariatric procedures, with as many as 65% of patients experiencing PONV within the first 24 hours. [1]

Considering the risk factors for PONV, the most influential patient-related risk factor is female gender; as many as 78% of female LSG recipients experience PONV within the first 24 hours after surgery compared with 26% of male patients.[1,2]

There are several critical anaesthesia related elements that are also responsible for PONV. Among those are the use of postoperative opioids, inhalational anaesthetics, and nitrous oxide, which have all been linked to inducing nausea and vomiting in the postoperative period.[3] The perioperative and postoperative administration of opioids commonly used in anaesthesia practice increases the likelihood of PONV.[1,2,3,4] In one study 7 of 10 patients (70%) receiving postoperative rescue opioid analgesics experienced PONV compared with 44% who did not receive opioids for postoperative pain control.[1]

On the other hand, inhalational Anaesthetics also do have an effect on PONV. Patients undergoing total intravenous anaesthesia (TIVA) experience significantly less postoperative severe nausea and retching compared with a classic inhalational balanced technique.[5] Researchers compared the use of desflurane, a commonly used inhaled vapor, with an intravenous (IV)-only regimen consisting of propofol and dexmedetomidine for patients undergoing LSG.[5] The TIVA group experienced a shorter duration in the post-anaesthesia care unit (PACU), thus indicating that the administration of a propofol-based TIVA was likely more beneficial in reducing PONV in the immediate postoperative period. In addition, there was a decreased need for rescue analgesia and ondansetron for PONV.[5]

Post-discharge nausea and vomiting (PDNV) refers to symptoms that occur after discharge for outpatient procedures. Post-discharge nausea and vomiting (PDNV) can be seen as a continuum of postoperative nausea and vomiting (PONV), but PDNV can also appear later, without a history of PONV immediately after anaesthesia or at the moment of discharge from the hospital.

The severity of PDNV and the distinction between nausea and vomiting are mostly important in the first three days after discharge. Post discharge vomiting is present in almost half of patients complaining of post-discharge nausea [6], and is obviously more frequent on the day of surgery if the discharge has been done on the same day. After arriving home 45% of patients experience nausea and 13% emesis, with almost 2 fold decrease on the first day after surgery (25% nausea and 5.2% vomiting). Seven days after discharge 6% of patients may still experience nausea and 0.8% emesis [7]. A third of patients rank post discharge nausea as 5 or more on a numeric rating scale from 0 to 10, with 10 being very severe nausea [8]

The risk factors for PDNV were extensively studied, mostly in the context of PONV. They include female sex, history of PONV or motion sickness, nonsmoking status, younger age (primarily < 50 years),, general versus regional anesthesia, use of volatile anesthetics, more than 1 hour of nitrous oxide based anesthesia, postoperative opioids, duration of anesthesia and type of surgery previous history of PONV; nausea before hospital discharge .[9]

Pain and at-home opioids or non-opioid analgesics administration may contribute considerably to the late or delayed PDNV (>24 hours postdischarge).

Mechanism of PONV & PDNV

There are several neurotransmitters responsible for producing an emetogenic response. These neurotransmitters include acetylcholine, serotonin, dopamine, histamine, and neurokinin-1.[10] Fortunately, selected pharmacologic agents can be used to inhibit the action of these neurotransmitters and thereby reduce the stimuli that lead to nausea and vomiting. Additionally, understanding the anatomical origins of nausea and vomiting may lead to a better understanding of why LSG recipients are vulnerable to PONV and PDNV. There are 4 pathways to the nucleus tractus solitarii in the hindbrain that activate vomiting.[4] These pathways include (1) the afferent vagal nerve fibers from the gastrointestinal tract itself, (2) vestibular stimulation, (3) the area postrema in the medulla oblongata, and (4) the forebrain. Because the LSG involves gastric manipulation and

incisions through afferent branches of the vagus nerve, it is hypothesized that stimulation of those nerve fibers is responsible for increasing the incidence of PONV/PDNV after LSG.[1,4] This risk may be increased because the manipulation of the procedure causes the release of 5-hydroxytryptamine from enterochromaffin cells in the stomach.

Treatment of PONV & PDNV:

Minimizing PONV following LSG is most successful when a multimodal approach with antiemetic medications is used rather than just a single drug.[4,11] In one study a 63% reduction of PONV was seen when patients were given prophylactic triple antiemetic therapy using haloperidol, ondansetron, and dexamethasone vs ondansetron alone.[11] Those 3 antiemetics also reduced postoperative morphine consumption nearly twofold compared with monotherapy with ondansetron.

The use of multimodal and opioid-free anesthesia, often combined with surgical wound local anesthetic infiltration provides excellent quality of recovery allowing patients to be pain-free at the time of discharge from the hospital. As no effective preventive strategies to rebound pain exist

In-hospital strategies to reduce PDNV are the same as those used to reduce and control PONV. Modifiable perioperative factors include fluid status, in addition to anesthesia and analgesia management. A non-restricted clear fluid intake before surgery and adequate intraoperative hydration may contribute to the reduction of early PDNV [12, 13]. Moderate certainty evidence supports the use of supplemental perioperative intravenous crystalloid administration in less morbid patients receiving general anesthesia for ambulatory procedures to prevent PONV/PDNV [12]. Opioid sparing techniques such as the use of regional anesthesia and analgesia [14], and total intravenous anesthesia (TIVA) with propofol and ketamine [15-18] also contribute to the PDNV risk reduction strategy.

The Resection distance (DP)

The resection distance from pylorus (DP) is defined as the distance from the pylorus towards the antrum at which resection during sleeve gastrectomy is done. Distances from 2-6cm are practiced today, and the amount of retained antrum determines its clinical significance. With a distance of 2 cm, more antrum is resected, and the gastric remnant is relatively smaller. This, in theory, will produce an increase in excess weight loss but may lead to more complications from the increase in distal intragastric pressure.

The relation between Resection distance and nausea and vomiting

Several studies have demonstrated the relation between resection distance and development of nausea & vomiting, some of which have been mentioned below.

1. Nocca et al., 2020 mention about their study where patients were randomly assigned in Group A– LSG with antral resection (172 patients) or Group B – LSG with antral preservation (174 patients). The baseline characteristics collected were demographics and anthropometric data (age, gender, body mass index), presence of postoperative complications, GERD - clinical characteristics ± pH-metry, or gastrin level. The results showed that the symptoms of nausea and vomiting were more significant for antrum resection group. [19]

2. Avlanmis et al., 2019 mention about their study which aimed to examine the effect of resection distance from pylorus in patients who underwent LSG for morbid obesity. A total of 390 patients who underwent laparoscopic sleeve gastrectomy for morbid obesity were included in this retrospective study. Patients were allocated into one of the two groups based on the distance between antrum resection margin and pylorus: group A, ≤ 3 cm and group B, > 3 cm. Follow-up data for %EWL and nausea/vomiting as well as demographical and perioperative data were retrospectively reviewed and logistic regression analysis was done. It was found that nausea/vomiting was more frequent in the ≤ 3 cm group only at 1-month visit (15% vs. 4%, $p < 0.001$). The findings indicate that a short distance between resection margin and pylorus is associated with better and sustained %EWL in LSG. However, these patients seem to be more prone to nausea and vomiting in the early

postoperative period. Further prospective large studies would help to define an optimal resection distance. [20]

Objective: This study aimed to examine the effect of resection distance from pylorus to antrum (DP) on nausea and vomiting during postoperative period, in patients who underwent LSG.

Methods:

3000 sleeve gastrectomy cases were retrospectively studied at our hospital and the number of cases with prolonged post-operative and post discharge nausea and vomiting were set asunder. Most of the cases having nausea and vomiting were of short duration (< 1 week) and were excluded from the study. The cases that met the inclusion criteria were the cases with prolonged duration of nausea and vomiting (weeks to months) and were 7 in number. These 7 cases had a severe course and it altered the patients' QOL (quality of life). These cases were deeply studied and the cause for the prolonged nausea and vomiting was compared with controls (Patients with no prolonged Nausea and vomiting Post-sleeve gastrectomy) and the findings were correlated with the surgery technique used and the resection distance opted. As for the surgical technique and resection distance, out of the 3000 surgeries studied retrospectively, the resection distance from pylorus to antrum used in the first 2200 surgeries was 2-4cm. Later on, after 2200 surgeries, amendments were made to the former operation technique, with a change in resection distance from pylorus to antrum to 4-6cm.

As for the cases with prolonged nausea and vomiting were studied in depth and were classified according to Clavien-Dindo classification, according to which 5 patients were classified as grade 3, 1 as grade 4 and 1 as grade 5.

Clavien-Dindo Classification of surgical complications [21]

Grade	
1	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Acceptable therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
2	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions, antibiotics and total parenteral nutrition are also included.
3	Requiring surgical, endoscopic or radiological intervention
3a	Intervention under regional/local anesthesia
3b	Intervention under general anesthesia
4	Life-threatening complication requiring intensive care/intensive care unit management
4a	Single organ dysfunction
4b	Multi-organ dysfunction
5	Patient demise

Case Reports:

Patient 1: A 30-year-old man with obesity class III and a BMI of 50.1 kg/m^2 follow up after 1 month showed a weight loss of 20 kgs. He was tolerating oral nutrition and medications well. The patient started to experience episodes of nausea and vomiting triggered by smell 1 week post gastrectomy. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all found to be unremarkable. He was started on medications namely Ondansetron and metoclopramide and his symptoms started to get better gradually until finally they resolved after 2 months

Patient 2: A 35-year-old man with obesity class III and a BMI of 47.9 kg/m^2. His past medical history comprised of post-laparotomy resection and anastomosis 20 years ago. He was a smoker. The patient started to experience episodes of nausea and vomiting triggered by smell 2 weeks post gastrectomy. The cause of nausea and vomiting had been investigated and the investigations:

Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all found to be unremarkable. He was started on medications namely Ondansetron and metoclopramide and his symptoms started to get better gradually until finally they resolved after $1^{1/2}$ months. Follow up after a month from surgery showed a weight loss of 22 kgs and He was tolerating oral nutrition and medications well

Patient 3: A 33-year-old woman with obesity class III and a BMI of >40. The patient started to experience episodes of nausea and vomiting triggered by both solid and liquid food 3 weeks post gastrectomy. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all found to be unremarkable except for the finding – Vitamin B1 deficiency. Thiamine supplementation and medications: Ondansetron and metoclopramide were started and her symptoms began to resolve after 1 month. She began tolerating oral nutrition and medications well.

Patient 4: A 39-year-old woman with obesity class III and a BMI of >45. The patient started to experience episodes of nausea and vomiting 3 weeks post gastrectomy and her course of treatment was 6 months. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) and even explorative laparotomy, were all found to be unremarkable except for rectal ulcer and haemorrhoids. The patient was later on admitted to the ICU for deteriorating condition and abnormal CBC with Hgb at 3g/dL which was followed by brain death.

Patient 5: A 37-year-old woman with obesity class II and a BMI of 37kg/m^2. The patient started to experience episodes of nausea and vomiting triggered by spicy food, 3 weeks post gastrectomy and her course of treatment was $1^{1/2}$ months. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all unremarkable except for Gallstones and cholecystitis. Cholecystectomy was done, however there was no alleviation in the symptoms of nausea and vomiting. She was started on Ondansetron and metoclopramide and her symptoms started to get better gradually until finally they resolved after $1^{1/2}$ months.

Patient 6:

A 34 -year-old woman with obesity class I and a BMI of 34 kg/m^2. The patient started to experience episodes of nausea and vomiting 2 weeks post gastrectomy. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all found to be unremarkable. She was started on Ondansetron and metoclopramide and her symptoms started to get better gradually until finally they resolved after 3 weeks.

Patient 7:

An 18-year-old boy with obesity class III and a BMI of 45 kg/m^2. The patient started to experience episodes of nausea and vomiting triggered mostly from seafood like shrimps, soon after gastrectomy. The cause of nausea and vomiting had been investigated and the investigations: Imaging (endoscopy, ultrasound, CT) Blood tests (CBC, electrolytes, ESR, LFT, Pancreatic enzymes, TSH) were all found to be unremarkable except for gallstones. He also demonstrated signs of post operative depression on psychiatric examination. He was started on Ondansetron and metoclopramide and was treated for 2 weeks after which he was lost to follow-up.

Results:

After the first 2200 cases, when the operating technique and resection distance from the pylorus to antrum for the 800 cases was changed, from 2-4cm to 4-6cm, , it was found that the symptoms of nausea and vomiting post sleeve gastrectomy became infrequent and same weight reduction results were obtained. No Incidence of prolonged nausea and vomiting (weeks or months) was noted at our hospital after adopting the antrum preservation technique when compared to the former technique showing a possible link between antral resection and the development of nausea and vomiting. Also

no major notable difference was noted in the percentage of Excessive weight loss (EWL) in antral preservation group when compared to antral resection group.

Conclusion:

1. Resection of greater portion of antrum during sleeve gastrectomy, i.e. 2cm from pylorus is directly related to an increase in the rate of development of post-operative/discharge nausea and vomiting.
2. Risks outweigh the benefits in sleeve gastrectomy with antral resection (resection 2cm from the pylorus) , therefore Antral preservation (resection 4-6cm from the pylorus) is a better alternative with low complication rate specifically in terms of development of nausea and vomiting.
3. Comparable weight loss results were obtained with both antral resection and antral preservation techniques with no major advantage seen with either method in terms of excessive weight loss percentage (EWL %)

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