



Aurora Pryor, MD



Andrew R. Luhrs, MD

SPECIAL SECTION

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Obesity: Management Strategies for Patients with Obesity and Related Diseases

AURORA PRYOR, MD;
ANDREW R. LUHRS, MD
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Obesity is a major healthcare problem across the planet. When we account for the metabolic diseases impacted by obesity, including type 2 diabetes, heart disease, cancer and others, obesity is the leading treatable cause of death. Obesity impacts patients of all ages and in almost all of our medical and surgical practices. There are now many effective ways to manage obesity and related diseases. In this special issue of the *Rhode Island Medical Journal*, we will highlight the most up-to-date management strategies for patients suffering from this common problem, presented in the following articles:

- Featured original work from **Viviane Fornasaro-Donahue, MS, RD, LDN**, and colleagues discussing intuitive eating behaviors and the role of anti-obesity medications.
- **Marcoandrea Giorgi, MD**, reviews the gut microbiome and its role in obesity.
- **Kristy Dalrymple, PhD**, and colleagues discuss the current weight loss recommendations for patients with psychiatric comorbidities.
- **Eva Koeller, MD**, and **John Romanelli, MD**, debate the role of bariatric surgery in the era of GLP-1 receptor agonists.
- For pediatric patients, **Artur Chernoguz, MD**, discusses practical recommendations.
- **Andrew R. Luhrs, MD**, contribution includes best practices in primary care and when to refer, as well as how to support patients before and after weight loss surgery.
- **Emily Ortega Goddard, MD**, reviews endoscopic therapeutic options to address obesity and related diseases.
- In an original contribution, **Beth A. Ryder, MD**, and colleagues demonstrate the use and efficacy of pre-operative aprepitant as an antiemetic in patients undergoing sleeve gastrectomy.
- Finally, the team from **Brown Health** presents a case on the successful endoscopic management of a subacute leak after sleeve gastrectomy.

We hope this issue helps provide some insight into the management of this important disease and helps to provide alternatives for our patients.

Authors

Aurora Pryor, MD, Professor & Chair of Surgery, Alpert Medical School of Brown University; Surgeon-in-Chief Rhode Island & the Miriam Hospitals, Providence, RI.

Andrew R. Luhrs, MD, Associate Professor of Surgery and Medical Science, Alpert Medical School of Brown University; Brown Surgical Associates, Providence, RI.

Correspondence

aurora_pryor@brown.edu

ALuhrs@brownhealth.org

Examining Intuitive Eating Behavior Across Metabolic and Bariatric Surgery and Non-Surgical Patients

VIVIANE FORNASARO-DONAHUE, MS, RD, LDN; CEREN GUNSOY, PhD; KATHLEEN J. MELANSON, PhD; LUCIA LARSON, MD

ABSTRACT

BACKGROUND: Intuitive Eating (IE) scales assess eating behaviors by capturing individuals' tendencies to rely on internal cues – such as hunger and satiety – rather than external influences like emotional factors or dieting mentality. IE data within the context of metabolic and bariatric surgery (MBS) patients seeking obesity management treatment remain limited.

OBJECTIVE: This study aimed to explore changes in Intuitive Eating Assessment Scale-2 (IEAS-2) scores among MBS and non-MBS patients and examine how individual-level factors, including obesity management medication (OMM), may influence these changes.

METHODS: We retrospectively analyzed 168 IEAS-2 responses from 84 patients at an obesity medicine clinic, including four subscales: (1) Unconditional Permission to Eat, (2) Eating for Physical Rather Than Emotional Reasons, (3) Reliance on Internal Cues, and (4) Body-Food Choice Congruence. Linear mixed-effects models assessed changes from baseline to follow-up and associations with OMM use, MBS status, depression, sleep duration, and physical activity.

RESULTS: Thirty-five non-MBS and 49 MBS patients (25 gastric bypass, 24 sleeve gastrectomy) were included, with a mean age of 47 ± 11.5 years and BMI of 41.5 ± 8.3 kg/m². Total IEAS-2 scores improved marginally over time ($p = .054$), irrespective of MBS status. OMM use ($p < .001$), physical activity ($p = .019$), and sleep ($p = .065$) were associated with better IE scores, while depression ($p < .001$) predicted worse outcomes.

CONCLUSIONS: Improvements in IE may be influenced more by individual-level factors – such as OMM use, lifestyle behaviors, and mental health – than by treatment modality alone, supporting the importance of interdisciplinary obesity care, integrating medical, psychological, and behavioral support.

KEYWORDS: Metabolic and Bariatric Surgery, Obesity Management Medication, Intuitive Eating, Eating Behavior, Obesity Treatment

INTRODUCTION

Obesity is a chronic, complex disease associated with an increased risk of developing severe health conditions,¹ currently affecting 41.9% of the United States population.² Treatment strategies typically include lifestyle interventions (e.g., dietary changes, sleep health, stress reduction, and physical activity), pharmacological therapies (i.e., obesity management medications; OMM, oral and injectables), and metabolic and bariatric surgery (MBS).³ While behavioral interventions can lead to modest (5–10%) but clinically meaningful weight loss and health improvements,^{4,5} sustaining these outcomes over the long-term remains a clinical challenge,^{6,7} with most individuals (80%) experiencing weight recurrence after the intervention concludes.^{8–10}

MBS is an effective and durable treatment for obesity and its comorbidities,¹¹ with about 70% of patients achieving a $\geq 50\%$ loss of excess weight. However, 20–30% may still experience suboptimal weight loss or weight recurrence.¹² More recently, pharmacological options – such as the injectables glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP) receptor agonists – have demonstrated efficacy in modulating appetite and satiety,¹³ resulting in 15–21% mean body weight reduction and a lower risk of obesity-related diseases.^{14,15} However, they also pose challenges including limited accessibility, regimen adherence, and potential side effects.¹⁶

A comprehensive, multidisciplinary approach to obesity management – including nutrition, physical activity, pharmacotherapy, surgical, and psychological support – is increasingly recommended to support positive health outcomes.^{18,19} Psychological factors, such as stress and depression, are linked to emotional eating and obesity,^{18,20} while insufficient or poor quality of sleep has also been associated with increased obesity risk and disordered eating patterns.^{21,22}

Each treatment – behavioral, surgical, and pharmacological – offer distinct benefits and challenges, particularly in terms of long-term adherence and weight recurrence. As these modalities increasingly overlap in clinical care,^{11,19} there is growing interest in understanding how they intersect with eating behavior patterns, and Intuitive Eating (IE), an evidence-based concept, may facilitate this understanding.

Intuitive Eating

IE promotes eating in response to physiological cues, such as hunger and satiety, rather than emotional cues, encouraging flexibility and self-compassion over restrictive dieting and rigid food rules.²³ Unlike traditional weight-centric models, IE and other health-centric approaches emphasize engagement in health-promoting behaviors and have been associated with favorable health outcomes.²⁴ Systematic review of non-weight-centric approaches has shown that IE and mindful eating are associated with reduced depressive symptoms, lower disordered eating, improved body image, greater fruit and vegetable intake, higher dietary fiber consumption, better quality of sleep, and increased physical activity.^{24–26}

The IE Assessment Scale-2 (IEAS-2) measures IE through four dimensions, which are described in more detail in the Methods section.²³ Counseling based on this assessment may support individuals by measuring their tendency to follow their hunger and satiety cues, thereby helping individuals make food-related decisions aligned with their physiological needs.²⁷

The present study integrates behavioral, psychological, and physiological variables related to obesity to emphasize the importance of comprehensive care. It investigates the intersection of MBS, pharmacological intervention, particularly OMM, intuitive eating, and lifestyle factors, such as physical activity, sleep duration, and experiences of depression. To our knowledge, this is the first study to examine these factors collectively, providing insight into how surgical and pharmacological treatments may relate to intuitive eating behaviors while considering lifestyle and psychological factors. Specifically, the study 1) explored the changes from baseline to follow-up in Intuitive Eating Assessment Scale-2 scores across non-MBS and MBS patients, and 2) examined how other variables, including OMM, may influence these scores.

METHODS

Study Design

This study employed a retrospective longitudinal design to compare the change in IEAS-2 scores overtime (i.e., baseline and follow-up) and across non-MBS and MBS patients. Data were collected at an obesity medicine clinic in the state of Rhode Island and received approval from the responsible Institutional Review Board.

Participants

Participants included non-MBS and MBS patients who visited the obesity medicine clinic between January 2021 and July 2023. Eligibility criteria included: all patients who (a) are 18 years of age or older, and (b) had completed the IEAS-2 at baseline and at follow-up as part of the clinic's standard of care. MBS patients in this sample likely represent a specific subgroup of bariatric surgery patients – those

experiencing either inadequate weight loss or weight regain – since patients with sustained success would be less likely to present to the clinic for further obesity management.

Data Collection

The following data were retrieved from electronic medical records using Research Electronic Data Capture (REDCap): (a) demographics of all participants, including age, date of birth, legal gender, marital status, employment status, race, and ethnicity, (b) the use or no use of OMM, (c) anthropometrics including weight, height, and body mass index (BMI), (d) the type of MBS and day of surgery, when applicable, (e) baseline and follow-up IEAS-2 completed by each patient, and (f) a brief health questionnaire about experiencing depression, sleep duration, and physical activity level.

Measures

The study examined IE responses across non-MBS and MBS patients, utilizing the IEAS-2. The scale is composed of 23 items distributed across four domains that indicate the core characteristics of intuitive eaters: (1) unconditional permission to eat, (2) eating for physical rather than emotional reasons, (3) reliance on hunger and satiety cues to decide when and how much to eat, and (4) body-food choice congruence.²⁸ Patients were instructed to answer 'yes' or 'no' for each statement, and when in between answers, they were instructed to pick the answer that most often applies to them.²⁹ For domains 1 and 2, each 'yes' is added up, and it represents an IE area that the individual may need to work on more. For domains 3 and 4, all 'no' answers are added and indicate the areas for improvement; thus, higher scores correspond to more negative IE outcomes. For easier analysis and interpretation, we standardized the scoring across the subscales so that lower IEAS-2 scores indicate better outcomes, as the individual has fewer areas to improve. Scores were not replaced if missed but the following criteria were applied: For subscales 1–3, if at least 50% of the questions were answered (i.e., 3 out of 6, 4 out of 8, and 3 out of 6 for subscales 1, 2, and 3, respectively), they were accounted for and added to the IEAS-2 subscales' total and overall scores. For subscale 4, the answers were accounted for if at least 2 out of 3 items were answered. The IEAS-2 subscales were calculated by counting the number of "yes" responses to items in subscales 1 and 2 and the number of "no" responses to items in subscales 3 and 4. Total scores were the sum of all subscales items.

Subscales

Unconditional Permission to Eat (UPE)

This subscale assesses individuals' permission – or lack of permission – to consume food when experiencing hunger without attempting to suppress it (e.g., "I don't allow myself to eat what food I desire at the moment"), categorize specific foods as off-limits (e.g., "I have forbidden foods that

I don't allow myself to eat") or as healthy/unhealthy (e.g., "I get mad at myself for eating something unhealthy"), and without rules that dictate what, when, and how to eat.^{28,29}

Eating for Physical Rather than Emotional Reasons (EPR)

This subscale represents whether individuals' eating decisions are in response to physical hunger or driven by emotional distress, such as anxiety, loneliness, or boredom. For example, "I find myself eating when I'm feeling emotional (i.e., anxious, sad, depressed), even when I'm not physically hungry."²⁸

Reliance on Hunger and Satiety Cues (RHSC)

This subscale assesses individuals' confidence in their internal hunger and satiety signals and their capacity to utilize these cues to regulate their eating behavior. For example, "I trust my body to tell me when to eat."²⁸

Body-food Choice Congruence (B-FCC)

The B-FCC subscale assesses individuals' reliance on making food choices that honor health and taste preferences, while maintaining a flexible nutrition approach, listening to how food makes one feel, without a rigid focus on healthy foods and perfection – "gentle nutrition."^{23,28}

Statistical Analysis

Descriptive analysis was used for all participants' characteristics and separated by surgical status (non-MBS and MBS). In Statistical Package for the Social Sciences (SPSS; IBM version 28.0.1.1), a linear mixed-effects model was selected to examine changes in intuitive eating total scores and subscales 1-4 across two time points (baseline and follow-up), comparing non-MBS and MBS groups. The model included variables: age, gender, marital status, race, ethnicity, employment, BMI, exercise level, depression, sleep duration, weight loss, and OMM status (coded as medication use: yes/no). A Confidence interval of 95% was employed, and statistical significance was determined at the $p < 0.005$ level.

RESULTS

A total of 168 IEAS-2 surveys from 84 patients were included in the analyses. The only demographic variable that differed between non-MBS and MBS patients was gender [Table 1].

Table 1. Participant Demographics

Frequencies Descriptives	Total, n (%) Mean $\pm$ SD	Non-MBS	MBS	Significance
Sample	84 (100)	35 (41.6/100)	49 (58.4/100)	>0.05
Type of Surgery				
Gastric Bypass, n			25 (52)	
Vertical Sleeve			24 (48)	
Initial Body Mass Index (kg/m ²)				
Mean $\pm$ SD	41.54 $\pm$ 8.3	42.64 $\pm$ 7.87	40.75 $\pm$ 8.6	.307
Age, years				
Mean $\pm$ SD	47.29 $\pm$ 11.5	46.74 $\pm$ 12.55	47.67 $\pm$ 10.81	.717
Gender				
Men	12 (14.3)	10 (28.6)	2 (4.1)	.002
Women	72 (85.7)	25 (71.4)	47 (95.9)	
Ethnicity				
Not Hispanic/Latino	71 (84.5)	27 (77.1)	44 (89.8)	.140
Hispanic/Latino	11 (13.1)	6 (17.1)	5 (10.2)	
Prefer not to answer	2 (2.4)	2 (5.7)	0	
Race				
Black	12 (14.3)	3 (8.6)	9 (18.4)	.229
White	62 (73.8)	27 (77.1)	35 (71.4)	
Other/Multiracial	8 (9.5)	3 (8.6)	5 (10.2)	
Prefer not to answer	2 (2.4)	2 (5.7)	0	
Obesity Management Medication (OMM) Use Initial Visit				
No use	68 (81.0)	27 (77.1)	41 (83.7)	.575
Yes use	16 (19)	8 (22.9)	8 (16.3)	
Time Elapsed Since Bariatric Surgery, years Median (Min-Max)			6.17 $\pm$ 6.59 5.3 (.18-40)	
Time Elapsed Initial to Follow-up Visit, days	129.6 $\pm$ 82.74	131.2 $\pm$ 92.73	128.4 $\pm$ 75.78	.881
Total Weight Loss Pounds	5.59 $\pm$ 12.4	7.22 $\pm$ 11.23	4.43 $\pm$ 13.18	.314

Of the 12 males who participated, two (16.7%) were in the MBS group whereas 47 (65.3%) of the 72 females were in the MBS group.

Changes in IEAS-2 total scores across time and between MBS and Non-MBS

We found a marginally significant main effect of time, $F(1, 102.82) = 3.79$, $p = .054$, suggesting that IE scores improved from baseline ($M = 9.48$, $SE = 0.55$) to follow-up ($M = 8.10$, $SE = 0.56$; see Figure 1). The main effect of bariatric status was not significant, $F(1, 72.03) = 1.68$, $p = .199$, nor was the Time $\times$ Bariatric Status interaction, $F(1, 78.05) = 0.17$, $p = .682$, indicating that IE change over time did not significantly differ between the MBS and non-MBS groups.

Examination of the variables revealed several significant predictors of intuitive eating. Medication use was significantly associated with lower (i.e. better) IE scores, $B = -3.11$,

Figure 1. Changes in IEAS-2 total scores across time between Non-MBS and MBS.

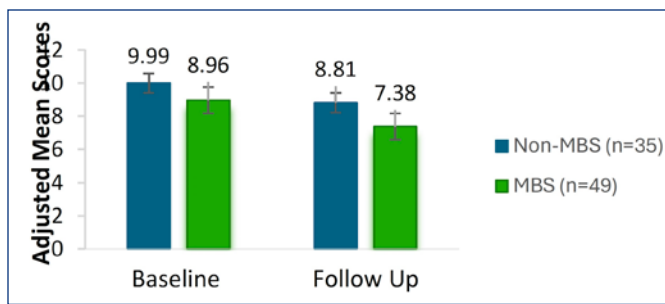
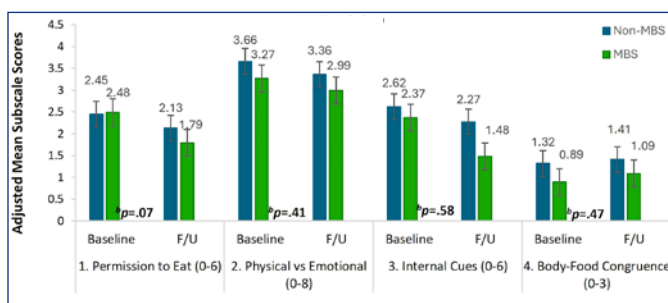


Figure 2. Changes in IEAS-2 Subscale Scores Across Time Between Non-MBS and MBS Adults^a.



a. Interaction between Time and Bariatric Status

b. P values indicate an effect of Time.

Note: Lower IEAS-2 scores = better outcomes

$SE = 0.83$, $t(128.63) = -3.77$, $p < .001$. Greater physical activity also predicted better IE outcomes, $B = -1.24$, $SE = 0.52$, $t(143.88) = -2.37$, $p = .019$. In contrast, depression was associated with higher (i.e., worse) IE scores, $B = 1.40$, $SE = 0.32$, $t(134.13) = 4.44$, $p < .001$, indicating poorer intuitive eating. There was a marginal effect of sleep, with longer sleep duration associated with better IE outcomes, $B = -1.09$, $SE = 0.59$, $t(133.34) = -1.86$, $p = .065$.

Changes in IEAS-2 subscale scores across time and between MBS and Non-MBS adults

Subscale 1: Unconditional Permission to Eat

There was a marginally significant main effect of Time, $F(1, 109.64) = 3.32$, $p = .071$, suggesting that Subscale 1 scores somewhat decreased (i.e., improved) from baseline ($M = 2.47$, $SE = 0.21$) to follow-up ($M = 1.96$, $SE = 0.20$). Although MBS had slightly better scores at follow-up, the main effect of Bariatric Status was not significant, $F(1, 73.18) = 0.20$, $p = .653$, with non-MBS participants ($M = 2.29$, $SE = 0.25$) showing similar Subscale 1 scores to MBS ($M = 2.14$, $SE = .20$). The interaction between Time and Bariatric Status was also not significant, $F(1, 79.31) = 1.00$, $p = .321$ (see **Figure 2** for adjusted mean score changes from baseline to follow-up separated per group).

Among all variables, OMM status was the only significant predictor, $B = -0.67$, $SE = .32$, $t(138.08) = -2.12$, $p = .036$. This

indicates that OMM use was associated with lower (i.e., better) unconditional permission to eat scores, controlling for other variables.

Subscale 2: Eating for Physical Rather than Emotional Reasons

IEAS-2 subscale 2 scores improved from baseline ($M = 3.47$, $SE = 0.29$) to follow-up ($M = 3.18$, $SE = 0.29$). However, the main effect of Time did not achieve statistical significance, $F(1, 94.56) = 0.68$, $p = .411$. The main effect of Bariatric Surgery Status was also not significant, $F(1, 70.71) = 0.53$, $p = .469$, with non-MBS participants ($M = 3.52$, $SE = 0.38$) not differing from MBS participants ($M = 3.14$, $SE = 0.32$). Additionally, the Time $\times$ Bariatric Surgery Status interaction was not significant, $F(1, 73.70) = 0.003$, $p = .958$, suggesting no differential change in Subscale 2 scores over time by surgery status [**Figure 2**].

Among the obesity-related variables, depression was a significant predictor of Subscale 2 scores, $B = .474$, $SE = .16$, $t(124.9) = 2.98$, $p = .003$, such that depression was associated with a greater likelihood of eating for emotional rather than physical reasons. OMM use was also a significant predictor, $B = -.818$, $SE = .41$, $t(115.3) = -1.99$, $p = .048$, with OMM use being associated with lower (better) Subscale 2 scores. No other covariates reached statistical significance ($p > .05$).

Subscale 3: Reliance on Internal Hunger/Satiety Cues

There was a marginally significant main effect of Time, $F(1, 102.19) = 3.66$, $p = .058$, with mean Subscale 3 scores decreasing (i.e., improving) from Baseline ($M = 2.50$, $SE = 0.25$) to Follow-up ($M = 1.88$, $SE = 0.24$). The main effect of Bariatric Surgery Status was not significant, $F(1, 71.61) = 1.60$, $p = .211$, with non-MBS participants ($M = 2.45$, $SE = 0.30$) not differing from MBS participants ($M = 1.93$, $SE = 0.25$), nor was the Time $\times$ Bariatric Status interaction, $F(1, 75.25) = 1.41$, $p = .238$, suggesting no differential change in reliance on internal cues scores over time by surgery status [**Figure 2**].

Among all variables, less reliance on hunger and satiety cues was associated with marital status ($B = 0.066$, $SE = 0.030$, $t(113.35) = 2.22$, $p = .028$) and depression ($B = 0.522$, $SE = 0.142$, $t(137.89) = 3.67$, $p < .001$). On the contrary, exercise level ($B = -0.526$, $SE = 0.232$, $t(144.32) = -2.26$, $p = .025$) and OMM use ($B = -0.830$, $SE = 0.375$, $t(132.98) = -2.21$, $p = .029$) were associated with better outcomes.

Subscale 4: Body-Food-Choice Congruence

The main effect of Time was not significant, $F(1, 104.93) = 0.53$, $p = .469$, indicating no major change in Subscale 4 scores from Baseline ($M = 1.11$, $SE = 0.16$) to Follow-Up ($M = 1.26$, $SE = 0.14$). The main effect of Bariatric Surgery Status was also non-significant, $F(1, 72.71) = 2.37$, $p = .128$, with non-MBS participants ($M = 1.37$, $SE = 0.18$) not differing from MBS ($M = .99$, $SE = 0.15$). Time $\times$ Bariatric Status interaction was non-significant, $F(1, 76.90) = 0.16$, $p = .687$, suggesting

no differential change in body-food-congruence scores over time by surgery status [Figure 2].

Regarding all variables, exercise level was associated with lower (i.e., better) body-food-congruence, $B = -0.35$, $SE = 0.14$, $t(143.36) = -2.51$, $p = .013$. Sleep duration and OMM use also predicted lower scores ($B = -0.32$, $SE = 0.16$, $t(137.67) = -2.01$, $p = .047$, and $B = -.66$, $SE = 0.23$, $t(136.36) = -2.89$, $p = .004$, respectively). Depression was linked to higher (i.e., worse) scores, $B = 0.35$, $SE = 0.09$, $t(141.19) = 3.99$, $p < .001$. All other covariates were non-significant ($p > .05$).

DISCUSSION

This study examined changes in intuitive eating behaviors among patients in an obesity management clinic, comparing those who had undergone MBS to those who had not. Overall, IEAS-2 scores showed marginal improvement over time, irrespective of MBS status, suggesting some progression in participants' intuitive eating. However, no significant bariatric status or Time $\times$ Bariatric Status interaction was observed, indicating that surgery status alone did not significantly influence IE outcomes.

Modest improvement in IE over time

The modest improvement observed in intuitive eating may reflect the gradual and non-linear nature of behavior change and habit formation.³⁰ Improvements may be related to the care and information provided at the clinical, but more research is needed to elucidate this relationship. The marginal effect of time could be partially explained by the relatively short interval between baseline and follow up (mean of 130 days), as behavioral change typically evolves gradually and unfolds overtime.^{31,32} Additionally, adopting IE may present challenges in weight management context, as IE is not inherently designed for weight loss.²³ Furthermore, the variability in follow-up timing may have diluted potential time-related effects, as participants had differing durations in which potential change could occur. These factors should be considered when interpreting the observed time effects and in planning future longitudinal assessments.

MBS and IE

MBS participants showed numerically greater improvements than their non-MBS counterparts, though this difference was not statistically significant. This trend may reflect patterns observed in prior research, which suggests that initial behavioral changes following MBS diminishes over time without structured follow-up.³³ While individuals who undergo MBS typically receive nutrition education during their pre- and post-operative process, their eating behaviors may be similar to those of non-MBS patients over time, potentially mirroring pre-surgery dieting behaviors.³⁴ This underscores the importance of sustained support, and IE may offer an opportunity for patients to reconnect with the

skills they learned around time of surgery. This will ensure more meaningful, lasting changes, especially when combined with other therapeutical strategies, such as OMM, and lifestyle interventions.³⁵

OMM and IE

A beneficial relationship was observed between the use of OMM and the IEAS-2 scores, both in the total score and across all four subscales. This may suggest a potential link between OMM and a healthier relationship with food and eating behaviors. OMM use emerged as a consistent predictor of improved IE scores, potentially due to its role in modulating physiological pathways that regulate appetite and satiety signaling,¹⁴ thereby supporting engagement with eating behavior changes.³⁰

Part of this effect may be explained by OMM's ability to regulate reward-seeking behaviors,³⁶ which may reduce what has been colloquially referred to as "food noise" – a constant preoccupation with food.³⁶ In the absence of persistent food thoughts and hunger, it is plausible to think that individuals may be less inclined to consciously engage in restrictive eating patterns (Subscale 1), fostering a more intuitive relationship with food that relies less on externally imposed rules. Furthermore, OMM may also support more attuned decisions regarding food, mind, and body (Subscales 2–4). Individuals may become more likely to eat in response to physical hunger rather than emotional cues, to consider how certain foods feel in their body and mind, and to choose foods that align with their body's needs. These findings suggest OMM may exert physiological and psychological influence on eating behaviors.³⁶

Lifestyle (physical activity and sleep duration) and IE

Physical activity level and sleep duration were also associated with improved IE outcomes, particularly in subscales related to eating in response to internal cues (Subscale 3) and body-food congruence (Subscale 4). These findings align with existing literature suggesting that physical activity and eating behaviors are interconnected, with greater physical activity supporting more autonomous and regulated eating patterns. For example, Fernandes et al (2023) found that higher levels of physical activity are associated with more self-determined eating regulation, characterized by reduced reliance on external rules or emotional cues.³⁷ Our results also align with the literature that supports that sleep duration is associated with better eating patterns.^{22,38} This may be due to the role that adequate sleep has in supporting regulation of appetite hormones, food intake, high-energy intake, and emotional eating.^{22,39}

Depression and IE

Depressive symptoms were consistently associated with poorer IEAS-2 outcomes, especially in domains related to emotional eating. This underscores the connection between

depressive symptoms and eating behavior as supported by current literature. Research has shown that depressive symptoms are closely associated to disordered eating patterns, including loss of appetite, overeating, binge eating, and weight gain in response to emotions, as individuals with depressive symptoms are more likely to rely on food as a coping mechanism.^{40,41} These findings emphasize obesity as a somatic comorbidity in mental health,^{42,43} reinforcing the importance of addressing psychological health within obesity management care.⁴⁴ The integration of holistic strategies – such as mindfulness-based interventions like intuitive eating – may support emotional well-being and reduce emotional eating among individuals undergoing weight management.^{35,44}

Considering these findings collectively, weight management interventions may depend not only on the treatment format itself but also on the interplay of psychological, behavioral, and physiological factors. Addressing modifiable variables such as physical activity, sleep, and depressive symptoms, along with pharmacological treatment and surgery may enhance the effectiveness of obesity management treatment.

CONCLUSION

This study offers novel insights into the role of intuitive eating within an obesity management context, particularly in relation to MBS and pharmacological treatment. While MBS status did not significantly predict changes in IE behaviors, individual-level variables – most notably OMM use, physical activity, sleep duration, and depressive symptoms – were consistently associated with IE outcomes. These findings suggest that treatment modality alone may not be sufficient to drive meaningful behavior change; rather, IE appears to hinge on a broader set of modifiable factors.

Importantly, the observed links between IE, lifestyle behaviors, and psychological factors reinforce the value of a multidimensional, patient-centered model of obesity care. Interventions that combine physiological support (e.g., OMM, MBS) with behavioral and psychological strategies (e.g., promoting physical activity, improving sleep, and addressing mental health) may enhance long-term outcomes.

Future research should explore intuitive eating trajectories over extended follow-up periods and assess the impact of tailored interventions – such as medication-assisted, surgical, and IE counseling programs – on more diverse populations across gender, race, ethnicity, and geographical location. As obesity care continues to evolve toward personalized, holistic treatment models, understanding the dynamic interplay between pharmacological, surgical, behavioral, and psychological influences will be essential to improving outcomes and eating behaviors.

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Authors

Viviane Fornasaro-Donahue, MS, RD, LDN, Center for Medical and Surgical Weight Loss, Brown University Health, Providence, RI; University of Rhode Island. Department of Psychology, Behavioral Sciences, Kingston, RI.

Ceren Gunsoy, PhD, University of Rhode Island. Department of Psychology, Behavioral Sciences, Kingston, RI.

Kathleen J. Melanson, PhD, University of Rhode Island. Department of Nutrition, Energy Balance Lab, Kingston, RI.

Lucia Larson, MD, Alpert Medical School of Brown University. Department of Medicine, Division of Endocrinology, Providence, RI.

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Correspondence

Viviane Fornasaro-Donahue, MS, RDN, LDN
164 Summit Avenue, Providence, RI 02906
401-793-3922
Fax 401-874-4216
vfornasarodonahue@brownhealth.org

Gut Health and the Microbiome: The Hidden Drivers of Obesity

MARCOANDREA GIORGI, MD

ABSTRACT

Obesity is a complex disease that spreads globally as a pandemic which affects all human activities from basic daily functions to advanced medical conditions that transform entire communities. The core factors of dietary excess and sedentary lifestyles continue to drive obesity but scientific evidence demonstrates that the gut microbiome plays a crucial role in regulating energy balance and body fat as well as metabolic wellness. High-throughput sequencing technology has transformed our understanding of this problem while showing how gut microbial communities affect nutrient absorption and host metabolism while protecting us from increased systemic inflammation. These new discoveries are emergent and promising to help us understand how to manage this complex multifactorial condition. This review examines the developing mechanisms through which gut microbes affect obesity while assessing preclinical and human study evidence and discussing potential therapeutic approaches to modify the microbiome for obesity treatment and its related conditions.

INTRODUCTION

Obesity affects over 650 million adults globally shaping our society in ways that barely one hundred years ago we thought impossible and is now a major risk factor for type 2 diabetes, cardiovascular disease, nonalcoholic fatty liver disease, and cancer; being one of the leading causes of death.¹ Traditionally, obesity has solely and mistakenly been attributed to caloric imbalance driven by high-energy diets and decreased physical activity which caused our society to start to increasingly blaming solely patients' life style choices without considering the problem from a 360-degree point of view. In fact, this way of thinking fails to fully explain an extraordinary interindividual variability in what medical providers see on a daily basis in weight gain, response to diet, or the persistence of obesity after caloric restriction.²

One of the most compelling developments in the last two decades is the recognition that the microorganisms colonizing the human gastrointestinal tract are in fact integral regulators of metabolism, immune function, and even behavior. This opened up a whole new field in bio-medicine driven to find more answers given the dramatic interindividual variability. Variations in the composition and diversity of the

microbiome have been linked to several disease processes that afflict patients nowadays, from cancer, to obesity and several metabolic dysfunctions in both animal models and humans.³ These observations have sparked a paradigm shift in the core views of many medical diseases: from viewing obesity solely because of lack of effort in the desire of being healthy which lead in our society to patient blaming and even at times shaming, to appreciating the role of host-microbe interactions potentially helping us to change the way we treat medical issues and patients as a whole.

This article reviews current evidence on the gut microbiome's role in obesity, highlighting key mechanistic insights, clinical observations, and translational approaches targeting the microbiome.

THE GUT MICROBIOME: AN OVERVIEW

The human gut microbiome is an extremely complex ecosystem that could be considered its own micro-universe, which includes bacteria, archaea, viruses, fungi, and protozoa, with bacteria being the most studied and with the highest potential for future research. The dominant bacterial phyla in the gut are Firmicutes and Bacteroidetes, followed by Actinobacteria and Proteobacteria.⁴

The microbiome of the human gut plays a key role for normal human well-being in general and in fact encodes functions critical for digestion of indigestible carbohydrates, production of short-chain fatty acids (SCFAs), vitamin synthesis, bile acid metabolism, and modulation of the immune system.⁵ In recent years there have been advances in metagenomic sequencing both for DNA and RNA that enabled researchers to characterize the microbial communities and their metabolic capabilities in unprecedented detail, this opened the scientific world to an enormous amount of information much of which still needs to be understood to be able to be utilized clinically in a meaningful way.

EVIDENCE LINKING THE MICROBIOME TO OBESITY

Preclinical Studies

A lot of work has involved the creation of models that could be utilized to explore the microverse of microbiome interaction; specifically for obesity, germ-free (GF) mouse

models have been instrumental in demonstrating that the gut microbiome contributes to host adiposity. The hypothesis that sparked the creation of such a model is the idea of assessing how the presence of bacteria influences tissue adiposity and its metabolism. In a landmark study, Bäckhed et al showed that GF mice colonized with microbiota from conventionally raised animals exhibited a 60% increase in body fat despite reduced food intake, suggesting enhanced energy harvest by the microbiota and a key role in determining body weight.⁶ This effect was further supported by Turnbaugh et al, who transplanted microbiota from genetically obese (ob/ob) mice into GF mice, which then developed significantly greater fat mass than mice colonized with microbiota from lean controls suggesting the key role of gut bacteria yet again.³

Subsequent animal models have identified specific microbial metabolic pathways that link gut bacteria to host energy balance; this was seen as a step forward by not looking at the specific bacteria, but how the product of its metabolism affected weight metabolism. One of the main mechanisms was found to involve the fermentation of non-digestible carbohydrates into short-chain fatty acids (SCFAs): primarily acetate, propionate, and butyrate, that were produced for the most part in the colon. SCFAs were found to serve as both nutrients and interestingly also as signaling molecules, which were hypothesized to have a role in regulating host appetite with promising clinical implications, lipid metabolism, as well as insulin sensitivity.¹²⁻¹⁴

Surprisingly though, certain studies have shown that even obese mice do exhibit increased levels of SCFAs in feces, which challenged the idea that they serve as protective factors, since other authors found that SCFAs were associated with having possible beneficial metabolic effects in lean animals. The different results from these studies suggested that obesity caused SCFA absorption dysfunction while altering the fermentation processes in the colon, which was confirmed by studies in both mice and humans.²³

Leaning deeper in this metabolic pathway given its promising potential, SCFAs are found to act through receptors such as free fatty acid receptor 2 (FFAR2), which has been shown to mediate appetite-regulating hormones like GLP-1 and peptide YY (PYY). To sustain this pathway, other studies appreciated how FFAR2 knockout mice do in fact become obese, while on the other side overexpression in adipose tissue leads to more lean phenotypes. In addition, these seemingly potent metabolic effects disappear under germ-free conditions, highlighting the critical role of the microbiota in this pathway.²³

Additional animal models have also shown that microbial metabolites such as SCFAs activate AMPK (or AMP-activated protein kinase) in liver and muscle tissues, which is a crucial enzyme that acts as a sensor of cellular energy status. AMPK is activated by conditions that lower cellular energy levels, and its activation triggers metabolic changes that promote

energy production and inhibit energy-consuming processes which makes it a key player in maintaining cellular energy balance and has implications for various metabolic disorders and diseases; specifically for our purposes it improves lipid and glucose metabolism.²⁴

On the other side, other studies focused on gut dysbiosis that may lead to impaired secretion of GLP-1 and PYY, resulting in increase in hunger. Mice lacking PYY exhibit in fact increased food intake and obesity, while mice with elevated PYY are resistant to diet-induced weight gain.²⁵

Inflammation is another key player for weight metabolism; additional authors have found that mice with dysbiosis show elevated systemic levels of lipopolysaccharide (LPS), a pro-inflammatory endotoxin derived from gram-negative bacteria that binds to TLR4 on macrophages, triggering inflammatory cascades via NF- κ B and contributing to insulin resistance and β -cell dysfunction; in fact, infusion of LPS into lean mice induces weight gain and metabolic syndrome-like features, suggesting a causal role of this molecule.¹⁶

These murine models not only establish causality but also offer potential targets for future therapies, including modulation of SCFA signaling pathways.

Human Observational Studies

Multiple studies in humans have associated obesity with reduced microbial diversity and altered relative abundances of bacterial taxa, and, specifically, several reports have identified imbalances in the relationship of Firmicutes-to-Bacteroidetes ratio in obese individuals compared to lean controls^{8,9}, suggesting a potential correlation of this potential imbalance. Important to remember that these two strains are in fact the most dominant bacterial phyla in the human gut making a large portion of the microbiome. These bacteria are respectively Gram positives and Gram negative and play a role in breaking down complex carbohydrates (Firmicutes) and fibers (Bacteroidetes) producing SCFAs. Bacteroidetes are often associated with leaner body mass and a healthier gut, as they are less efficient at extracting calories from food compared to Firmicutes. However, this observation is not universal across all cohorts; in fact there are several differences when looking at patients' geographic, dietary, and other characteristics.¹⁰

Inflammation also plays an important role in altering metabolic pathways and impacting SCFAs, and in many studies patients with obesity have in fact been found to have higher levels of pro-inflammatory endotoxins contributing to dysbiosis and alterations in said metabolic pathways.¹¹

MECHANISMS LINKING THE MICROBIOME TO OBESITY

Enhanced Energy Harvest

The first proposed mechanism involves the microbiome's capability to enhance the extraction of calories from

indigestible polysaccharides which affects appetite and satiety and absorption; in fact, microbial fermentation generates SCFAs such as acetate, propionate, and butyrate, which can be absorbed by the host and could even contribute up to 10% of daily caloric requirements and they also function as signaling molecules affecting lipid and glucose metabolism via G-protein coupled receptors (e.g., GPR41, GPR43).^{12,13}

Regulation of Lipogenesis

Acetate, the most abundant SCFA, has been implicated in promoting lipogenesis in the liver, so microbial metabolites modulate expression of genes such as acetyl-CoA carboxylase and fatty acid synthase, enhancing triglyceride accumulation contributing to weight gain.¹⁴

Modulation of Satiety and Appetite

The gut microbiota helps controlling satiety through SCFA production and enteroendocrine cell regulation which results in butyrate and propionate stimulating PYY and GLP-1 hormone secretion that suppress appetite and enhance insulin sensitivity.¹⁵ In a state of dysbiosis these signals may be attenuated, favoring increase in appetite and calorie intake.

Metabolic Endotoxemia

Certain Gram-negative bacteria in the human gut produce lipopolysaccharide (LPS), which is a strong endotoxin that can lead to increased gut permeability during dysbiosis, allowing translocation of LPS into circulation, which will trigger low-grade inflammation and insulin resistance.¹⁶ This endotoxemia has been proposed as a one of the drivers of obesity-related inflammation, activating other metabolic cascades.

Bile Acid Metabolism

Bile is an important factor in GI metabolism and absorption, and is well regulated by several hormones and stimuli. The microbiome interacts with bile acids in a continuous manner through a vital connection where gut bacteria convert primary bile acids into secondary bile acids which activate nuclear enteric cell receptors including farnesoid X receptor (FXR) and G protein-coupled bile acid receptor 1 (TGR5) to control lipid metabolism and glucose homeostasis and energy expenditure.¹⁷

THERAPEUTIC MODULATION OF THE MICROBIOME IN OBESITY

Given the microbiome's role in obesity, interventions aiming to restore eubiosis have attracted considerable interest, interventions range from dietary changes and the constant search of the "perfect diet" to medical treatments that have pushed the medical industry into creating a billion-dollar market with thousands of over-the-counter remedies to "restore" the microbiome.

Diet

Diet remains the most powerful modulator of the gut microbiome with the highest chance of impact, specifically high-fiber diets rich in complex carbohydrates promote SCFA-producing bacteria and microbial diversity carrying along several health benefits¹⁸; on the other side, Western diets high in fat and refined sugar drive dysbiosis and possibly metabolic derangements that over the years can lead not only to obesity but also to other several disease processes; many studies have in fact shown that dietary interventions can rapidly shift microbiome composition within days, emphasizing this important role.¹⁹

Probiotics

Probiotics are live microorganisms that are hypothesized to confer health benefits and have been historically very well tested in obesity management, especially strains including *Lactobacillus* and *Bifidobacterium* species, but unfortunately several meta-analyses suggest that probiotic supplementation modestly reduces body weight and BMI, though results are heterogeneous and strain-specific.²⁰

Prebiotics

Prebiotics, such as Inulin and fructooligosaccharides, are nondigestible substrates that promote the growth of beneficial microbes which then increase SCFA production; this has been associated in certain studies to create improved glucose regulation but unfortunately still with modest weight loss.²¹

Fecal Microbiota Transplantation (FMT)

FMT is a novel technique that involves transferring stool from healthy donors to recipients to restore microbial balance. It is based on the theory of introducing a healthy person microbiome into a patient with dysbiosis hoping to restore balance, but while FMT has shown success in treating both acute and recurrent *Clostridioides difficile* infections at times resistant to antibiotic therapy, its application in obesity remains experimental. A landmark study demonstrated that FMT from lean donors improved insulin sensitivity in obese recipients, but effects on weight were inconsistent.²²

LIMITATIONS AND FUTURE DIRECTIONS

While the association between the microbiome and obesity is compelling, several challenges remain:

- **Causality vs. Correlation:** Many studies are observational and cannot establish causality.
- **Interindividual Variability:** Microbiome composition is influenced by genetics, diet, geography, and medications.
- **Translational Gaps:** Findings in animal models may not fully translate to humans.

- **Durability of Interventions:** Microbiome shifts often revert after discontinuation of dietary or probiotic interventions.

Future research integrating multi-omics (metagenomics, metabolomics, transcriptomics) with longitudinal cohorts may clarify causal pathways and enable personalized microbiome-targeted therapies.

CONCLUSION

The gut microbiome functions as a vital system which controls host metabolic processes, inflammatory responses and energy equilibrium. While eubiosis remains the desired hallmark of a healthy gut, dysbiosis has been proven to contribute to the pathogenesis of obesity through increased energy harvest, altered gut hormone signaling, endotoxemia, and alterations of bile acid pathways. Promising microbiome-directed interventions are emerging and promising, but large-scale clinical trials are still needed to define their efficacy and durability. A deeper understanding of host-microbe interactions may ultimately yield transformative strategies to prevent and treat obesity.

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Author

Marcoandrea Giorgi, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

Disclosures

Marcoandrea Giorgi serves as a consultant for BD.

Correspondence

Marcoandrea Giorgi, MD
195 Collyer St, Suite 302, Providence, RI 02904
401-793-5701
Fax 401-793-5171
mgiorgi@brownhealth.org

Psychiatric Comorbidities and Weight Loss Recommendations in Bariatric Surgery Patients

KRISTY DALRYMPLE, PhD; CRISTINA TOBA, MD

ABSTRACT

Metabolic and bariatric surgery is increasingly utilized as a treatment for obesity worldwide. Despite significant weight loss, weight regain can occur long-term with bariatric surgery, with factors related to weight regain including the presence of comorbid psychiatric conditions. Psychiatric comorbidity in bariatric surgery candidates is common; although these comorbidities sometimes improve in the short-term, they may worsen in the long-term or new problems may emerge post-surgically. Many patients may continue to take psychotropic medications after surgery to maintain behavioral health, yet some medications are associated with weight gain or may pose certain risks due to changes in pharmacokinetics following surgery. The research on psychiatric comorbidity in bariatric surgery patients is presented, along with a review of psychotropic medications that may pose risks of weight gain post-surgically. Clinical recommendations are provided based on existing evidence with respect to managing psychiatric comorbidity in patients in ways that can optimize behavioral health outcomes while also ensuring positive outcomes with bariatric surgery.

KEYWORDS: Psychiatric Comorbidity, Medication, Psychotherapy, Bariatric Surgery

INTRODUCTION

Metabolic and bariatric surgery is increasingly utilized as a treatment for obesity worldwide,¹ with the most common procedures being Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG). Maximum weight loss is achieved in the first one-two years post-surgery,² with additional long-term benefits.³ Despite significant weight loss, weight regain can occur long-term with bariatric surgery, with factors related to weight regain including the presence of comorbid psychiatric conditions and challenges in adjusting to the new social demands after weight loss surgery.^{4,5} The following review will focus on psychiatric comorbidity in bariatric surgery patients, its impacts on surgical outcomes, and evidence-based clinical recommendations for managing this comorbidity pattern in bariatric surgery candidates.

OBESITY-PSYCHIATRIC COMORBIDITY IN BARIATRIC SURGERY CANDIDATES

Psychiatric comorbidity in bariatric surgery candidates tends to be higher compared to the general population and those experiencing obesity but who are non-treatment seeking.⁶ Individuals seeking medical interventions for obesity are more likely to have medical comorbidities, including diabetes, obstructive sleep apnea, and cardiovascular disease, and these severe medical conditions are associated with high levels of psychiatric conditions such as depression.⁷

As many as 81% of bariatric surgery patients have met criteria for at least one lifetime psychiatric disorder at the pre-surgical evaluation, with mood and anxiety disorders being the most common.⁸ The most common lifetime disorders are affective disorders (e.g., major depression), while the most common current disorders are anxiety disorders.⁶ One study of over 1,000 bariatric surgery candidates found that specific phobia was the most prevalent current disorder (9.0%), followed by social anxiety disorder (7.9%).⁹ However, some studies have found that eating disorders were the most common current diagnosis, and other studies have demonstrated a high prevalence of posttraumatic stress disorder (PTSD) in bariatric surgery candidates.⁶ Even in the absence of PTSD, rates of childhood trauma (particularly childhood sexual trauma) tend to be higher in this population.⁶ In addition to being associated with PTSD, childhood trauma is associated with problematic eating behaviors and obesity.⁶

Rates of substance use disorders are low in presurgical candidates relative to other disorders (e.g., 7.6% in the Longitudinal Assessment of Bariatric Surgery [LABS-2] study),¹⁰ yet overall use of substances pre-surgically may be high and may confer certain risks after surgery. Alcohol use has been as high as nearly 75% in bariatric surgery patients, with high-risk drinking in 17% of pre-surgical candidates.¹¹ Although alcohol use decreases following surgery, a percentage of patients experience the emergence of new-onset alcohol use problems or disorder post-surgically, particularly for those receiving the RYGB procedure.¹¹ Similar findings have occurred with other substances.¹²

IMPACT OF PSYCHIATRIC COMORBIDITY AND CORRELATES ON SURGICAL OUTCOMES

Psychiatric comorbidities tend to improve in the short-term, particularly one-two years post-surgery.⁸ However, results from longer-term follow-up studies indicate that a decline in behavioral health tends to occur as many as 10 years after surgery.^{13,14} A nine-year follow-up study showed there was a 32% increase in mood and eating disorders over the follow-up period compared to the pre-surgery period, with peak prevalence occurring at 72–96 months post-surgery.⁸

Findings are mixed as to whether psychiatric disorders are related to insufficient weight loss or weight regain after bariatric surgery. For example, mood, anxiety, and binge-eating disorders are associated with poorer weight loss outcomes up to 50 months after surgery.¹⁵ Conversely, seven years after surgery there is an inconsistent relationship between the presence of presurgical psychiatric disorders and weight loss outcomes.⁴ Although one recent study showed that the prevalence of psychiatric disorders increased over the post-surgical period, they also found that psychiatric disorders were not associated with percent excess weight loss over the post-surgical period.⁸

These mixed findings could be due to the variability in how psychiatric disorders were assessed. When using semi-structured diagnostic interviews, different types of instruments can be used, and prevalence rates may differ based on the assessment instrument.⁶ Other studies have used unstructured clinical interviews, which often underdiagnose psychiatric conditions.¹⁶ The degree to which the assessment process was independent of the presurgical approval process may also impact prevalence rates. When the assessment is a formal part of the surgical clearance process, symptoms may be underreported by patients due to fears of not being cleared.⁶ Furthermore, mixed findings could be due to the range of disorders that are assessed; some studies have examined only single disorders, while other studies have assessed a range of psychiatric disorders.⁸

One correlate of psychiatric conditions, emotional eating, has been found to affect surgical outcomes. Emotional eating is defined as eating with the intended function of reducing stress or emotional upset. It has been shown to occur in 24–40% of bariatric surgery candidates, even in those with no lifetime psychiatric disorder.^{9,17} Pre-surgical emotional eating severity is significantly associated with poorer weight loss following RYGB, laparoscopic adjustable gastric band, and biliopancreatic diversion,¹⁸ although one study found that it was associated with increased odds of postsurgical weight loss success.¹⁹ It is also significantly associated with higher levels of anxiety and depression in bariatric surgery candidates.^{17,20}

Perhaps psychiatric conditions have an indirect, rather than direct, effect on weight loss outcomes. Psychological factors such as mindfulness (e.g., nonjudgmental stance towards emotions and thoughts) have mediated the relationship

between depression symptoms and emotional eating pre-surgically, such that higher levels of depression symptoms were associated with greater emotional eating through higher levels of judgment towards thoughts and feelings.²¹ Other studies showed that higher levels of mindfulness skills were associated with lower engagement in problematic eating behaviors, including emotional eating.²² Emotion regulation skills may also be an important psychological factor to address, as it has been associated with problematic eating behaviors such as emotional eating in bariatric surgery candidates.²³

WEIGHT GAIN AND PSYCHOTROPIC MEDICATIONS

In the LABS study,²⁴ 40% of 4500 presurgical candidates were taking an antidepressant medication (AD). ADs are the most prescribed psychotropic medications and are often continued during the post-surgical period, unlike medications for medical comorbidities. Overall, 65% of patients taking ADs report a side effect of weight gain, with 21% having a higher risk of greater than 5% weight gain compared to those not taking ADs. Across all ADs, tricyclics, MAOIs, and mirtazapine have the highest risk for weight gain.²⁵

A recent review²⁵ showed that within selective serotonin reuptake inhibitors (SSRIs), paroxetine and citalopram have the highest risk of weight gain, while fluoxetine and sertraline are generally weight-neutral but may cause weight gain with long-term use. Compared with sertraline, escitalopram, paroxetine, and citalopram were associated with greater weight gain at six months, while fluoxetine was weight-neutral and bupropion was associated with weight loss. Serotonin norepinephrine uptake inhibitors (SNRIs) can cause weight gain, but the effect is less pronounced than with some other AD classes. Short-term studies show weight neutrality or even slight weight loss with SNRIs, but weight gain risk becomes higher with longer-term use. The risk of weight gain with SNRIs is lower than with tricyclic antidepressants or mirtazapine, but higher than with bupropion.²⁵ Tricyclic antidepressants (TCAs) can cause significant weight gain, with amitriptyline being the most potent TCA for inducing weight gain. The Endocrine Society recommends that clinicians consider the risk of weight gain when selecting AD therapy, especially for patients at risk for obesity or metabolic complications.²⁶

For mood stabilizers, lithium, valproic acid derivatives, and gabapentin are associated with significant weight gain, while carbamazepine has a low risk of weight gain. Lamotrigine and topiramate are associated with weight loss or are weight-neutral.²⁶ A systematic review showed that valproate is associated with weight gain in up to 50% of users, often detectable within two–three months of initiation, while carbamazepine carries a lower but present risk.²⁵

Second-generation antipsychotics are associated with

significant weight gain and other metabolic side effects (e.g., glucose dysregulation). Clozapine and olanzapine have the highest risk for weight gain among atypical antipsychotic medications, followed by quetiapine, risperidone, and paliperidone. The lowest risk for weight gain in antipsychotic medications is with aripiprazole and ziprasidone. This pattern is consistent across adult and pediatric populations, and the risk is particularly pronounced in antipsychotic-naïve patients. Newer antipsychotic medications lurasidone and cariprazine are associated with some weight gain, but the magnitude is generally lower than many other second-generation antipsychotics. Both drugs are considered to have a favorable metabolic profile regarding weight gain, but monitoring is still recommended as part of standard care for all atypical antipsychotics.²⁷

EARLY SURGICAL RISKS OF PSYCHOTROPIC MEDICATIONS AND IMPACTS ON SURGICAL OUTCOMES

Some research suggests that a possible risk with lithium is lithium toxicity immediately following surgery. For the SSRIs, some research has shown that they are associated with upper GI bleeding. Due to disruptions in taking medications immediately post-surgery, or due to early changes in pharmacokinetics, problems such as SSRI discontinuation syndrome or withdrawal symptoms may occur. There may be a higher risk with this related to venlafaxine because of its short half-life.²⁵

Research on changes in pharmacokinetics has been more well-established for RYGB than for sleeve gastrectomy, due to changes in the surface area of the small intestine that impacts medication absorption, changes in pH levels, changes in gastric emptying times, changes in gastric motility, and changes in drug metabolism. Sertraline exposure was 40% of that in non-surgical matched controls, and maximal plasma concentration was lower than matched controls one year after RYGB.²⁸ Duloxetine exposure was approximately 60% of that in non-surgical matched controls, and there was a shorter time to maximal plasma concentration compared to matched controls.²⁹ However, there was no difference in pharmacokinetics related to lisdexamfetamine compared to matched non-surgical controls.³⁰ Other studies have found reduced bioavailability for various SSRIs and SNRIs at one month post-surgery,³¹ reduced serum concentrations post-RYGB with escitalopram,³² and reduced drug absorption post-RYGB for haloperidol, lithium, risperidone, valproate, lurasidone, and paliperidone long-acting injection.²⁵ For the treatment of addictive disorders, changes in methadone or buprenorphine absorption may occur, which could lead to issues such as respiratory depression or opioid use disorder relapse.²⁵

Some individuals treated with ADs after surgery have experienced worsened outcomes one year post-surgery.

However, there have been mixed findings with the association between AD use and weight loss outcomes in bariatric surgery. Some studies have indicated lower percent total weight loss in those taking ADs 24 months after RYGB surgery, compared to those not taking ADs.³³ Other studies have shown no association between AD use and weight loss outcomes in bariatric surgery.³⁴

TREATMENT APPROACHES FOR MITIGATING MEDICATION-RELATED WEIGHT GAIN

Medication Approaches

Because of the prevalent use of psychotropic medications in this population, it is important to optimize psychiatric outcomes and minimize weight gain that can occur from these medications to facilitate surgical success. For patients who need to continue with psychotropic medications after surgery, it is recommended to consider decreasing the dose to the lowest therapeutic level possible while monitoring symptoms, or switching to medications with more weight-neutral properties. Add-on medications could be considered, when appropriate, that would assist in reducing weight gain with these medications. Such medications may include topiramate, metformin, or liraglutide.^{35,36}

Metformin is the most evidence-based adjunct for both prevention and treatment of psychotropic-induced weight gain and is recommended as first-line adjunctive therapy when lifestyle interventions are insufficient and switching agents is not feasible. Metformin may be co-commenced with psychotropic drugs that have weight gain liability (e.g., olanzapine: OLZ-MET) if an alternative agent with lower weight gain liability is not an option.³⁷ OLZ-MET has been shown to decrease weight gain in both obese and non-obese populations. Olanzapine-samidorphan (OLZ-SAM) is a newly approved option for the treatment of schizophrenia and bipolar I disorder, which has demonstrated reduced weight gain in a non-obese population.³⁸ GLP-1 receptor agonists, although less studied than Metformin, have shown promise in mitigating psychotropic-induced weight gain. The overall weight loss attributed to GLP-1 receptor agonists is significantly greater than any other class of bariatric medicine, although long-term safety and efficacy data are still accruing.³⁷

Topiramate is an off-label option for managing psychotropic-induced weight gain, particularly when first-line strategies are inadequate, but requires individualized risk-benefit assessment and monitoring for adverse effects. Cognitive dysfunction, paresthesia, and fatigue are dose-dependent and may lead to discontinuation in a subset of patients; careful monitoring is recommended.³⁵ For lithium, levels should be closely monitored before and after surgery; for other medications with defined therapeutic ranges, serum concentration levels should be closely monitored. For medications with short half-lives, it is important to provide education on SSRI

discontinuation symptoms that may occur post-surgery due to changes in pharmacokinetics. Should these symptoms occur, a possible recommendation is to increase the AD dose after surgery to address these symptoms. For patients who are stable on medication type and dosage pre-surgery but there is a concern of relapse, trough serum levels could be obtained to allow for comparison with post-surgery levels to monitor symptoms.²⁵ Overall, it is recommended that measurement-based care be used to monitor symptoms pre- and post-surgery, to allow for efficient adjustments in the treatment plan. Furthermore, collaboration between the surgical team, the pharmacotherapy specialist, and primary care provider is essential in maintaining stability of comorbid psychiatric conditions and ensuring surgical success.

Psychosocial Approaches

As a first step, it is of critical importance to conduct a comprehensive pre-surgical behavioral health evaluation. This has now become the standard of care and is recommended as part of the multidisciplinary screening process prior to bariatric surgery.³⁹ Such evaluations should include the use of semi-structured interviews and psychometric testing as a part of evidence-based evaluation.³⁹ In addition to identifying the presence of psychiatric conditions and correlates that could negatively impact surgical outcomes, these evaluations provide other benefits such as enhancing readiness for surgery, increasing knowledge about post-operative recommendations, addressing possible barriers to surgical success, and providing a positive connection with a behavioral health specialist to support treatment engagement in the future should the patient need it.³⁹

Presurgical psychosocial interventions can provide an important opportunity to strengthen coping skills and healthy habits to ensure post-surgical success. Cognitive behavioral therapy (CBT) is recommended as a first-line psychosocial treatment to address depression, anxiety, and eating disorders. Studies have found that CBT provided pre-surgically resulted in improvements in dysfunctional eating/binge eating, depression, and anxiety post-intervention,⁴⁰ and significant weight loss at six and 12 months post-surgery.⁴¹ Post-surgical psychosocial interventions and support groups also have resulted in greater weight loss,⁴² and can improve problematic eating behaviors, depression, and weight outcomes in those who have experienced weight regain following RYGB.^{43,44}

CONCLUSION

Psychiatric comorbidity is prevalent in bariatric surgery candidates. Findings thus far have been mixed concerning the impact of these comorbidities on surgical outcomes, but many individuals continue to experience psychiatric comorbidities post-surgery or develop new ones post-surgically. For those who continue to experience psychiatric

comorbidities, it is important to consider ongoing management of these conditions post-surgically in ways that reduce the risk of weight gain (e.g., weight-neutral medications and psychosocial interventions). Other correlates are present even in the absence of psychiatric conditions that can negatively affect surgical outcomes, such as problematic eating behaviors. Comprehensive pre-surgical behavioral health assessments are crucial to identifying psychiatric conditions or correlates to determine appropriate treatment plans to ensure that patients receive adequate care and positive bariatric surgical outcomes.

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Authors

Kristy Dalrymple, PhD, Brown Health Medical Group, Department of Psychiatry, Alpert Medical School of Brown University, Department of Psychiatry and Human Behavior, Providence, RI.
Cristina Toba, MD, Brown Health Medical Group, Department of Psychiatry, Alpert Medical School of Brown University, Department of Psychiatry and Human Behavior, Providence, RI.

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Correspondence

Kristy Dalrymple, PhD
146 West River Street, Suite 11B, Providence, RI 02904
401-444-7095
Fax 401-444-7109
kdalrymple@brownhealth.org

The Role of Bariatric Surgery in the Era of GLP-1 Receptor Agonists

EVA KOELLER, MD; JOHN ROMANELLI, MD

ABSTRACT

Obesity continues to be a significant public health issue resulting in morbidity, premature mortality, and substantial costs to the healthcare system. Effective treatments for obesity and its associated co-morbidities exist. Bariatric surgery has been well studied and shown to be safe and effective. Glucagon-like peptide receptor agonists (GLP-1 RAs) are relatively newer but have also been shown to result in substantial weight loss. We reviewed the current literature on both bariatric surgery and GLP-1 RAs and will present the pros and cons of each as well as a discussion of the roles they play in treating obesity. Our goal was to provide a comprehensive reference that can be used by all providers treating obesity to have educated discussions about the current state of treatment options with their patients.

KEYWORDS: Obesity, Bariatric Surgery, GLP-1 Receptor Agonists

INTRODUCTION

Obesity is a widely prevalent medical condition affecting 40% of Americans and 30% of Rhode Islanders.^{1,2} The pathophysiology of obesity is still not completely understood and involves a complicated interplay between a variety of hormones and neural pathways as well as the influence of an individual's genetic makeup, environment, socioeconomic status and comorbidities.^{1,3} Obesity is associated with increased risk of cardiovascular disease, type II diabetes mellitus (DM), obstructive sleep apnea (OSA), cancer, osteoarthritis, and premature death and results in hundreds of billions of dollars in direct medical costs annually.^{1,4,5} The mainstay of treatment for obesity is behavioral change including adopting a healthy diet and increased physical activity; however, this results in insufficient weight loss in a significant number of patients.⁶ Since its advent in the 1950s, bariatric surgery has emerged as an increasingly safe and effective option.⁶ More recently, anti-obesity medications, specifically glucagon-like peptide receptor agonists (GLP-1 RAs), have become increasingly popular with their use for obesity treatment doubling between 2022 and 2023, while the rates of bariatric surgery during that time

decreased by 8.7%.⁷ This review will highlight the pros and cons of GLP-1 receptor agonists, compare them to bariatric surgery, and show how the two modalities each have roles both as adjunctive and independent treatments for obesity.

BARIATRIC SURGERY

Long-term data has shown that bariatric surgery is a safe and effective means of achieving significant weight loss. Undergoing bariatric surgery alters more than just a patient's anatomy. It shifts their metabolic setpoint affecting hypothalamic gene expression and changing fat and hormone levels, including increasing GLP-1 secretion, which contributes to changes in caloric intake and energy expenditure.^{3,8,9} Currently, bariatric surgery is recommended in patients with a BMI of ≥ 35 or 30–34.9 with obesity-related co-morbidities such as hypertension, DM, hyperlipidemia, and OSA. The two most common procedures are the sleeve gastrectomy, which accounted for 58.2% of all bariatric procedures in 2023 and the Roux en Y gastric bypass (RYGB), which made up 23.4% of bariatric procedures in 2023.¹⁰ Patients lose, on average, 57% of their excess weight after sleeve gastrectomy and 67% of excess weight after RYGB.¹¹ Bariatric surgery also effectively treats comorbidities such as DM and cardiovascular disease and has been shown to reduce mortality in studies with long-term follow-up.^{1,11–14} A Cochrane review of 22 trials found that, regardless of the procedure, bariatric surgery was more effective than any non-surgical option for achieving weight loss and improvement in associated co-morbidities.¹⁵ There have also been many studies showing that bariatric surgery is cost effective despite the relatively high up-front price tag.^{16–19} However, some patients do experience insufficient weight loss or weight regain in addition to post-operative complications, which are procedure dependent but include stenosis (1–19%), leak (.6–7%), internal hernia and marginal ulcer (2.5–5%), nutritional deficiencies, and dumping syndrome in addition to standard peri-procedural risks.^{8,20}

GLUCAGON-LIKE PEPTIDE 1 RECEPTOR AGONISTS

GLP-1 RAs are relatively newer in the world of obesity medicine. They were initially developed to treat diabetes mellitus but were found to result in significant weight loss. Two

GLP-1 RAs, liraglutide and semaglutide, are now FDA-approved to treat obesity and have been shown to result in loss of as much as 20% of excess body weight.⁶ Current guidelines support the use of anti-obesity medications in non-pregnant patients with BMI ≥ 30 or BMI ≥ 27 with associated co-morbidities who have had an inadequate response to lifestyle changes.^{3,21} GLP-1 RAs mimic the action of the hormone glucagon-like peptide acting on the hypothalamus and leading to appetite suppression as well as delayed gastric emptying, increased insulin release, decreased glucagon secretion and increased growth of pancreatic beta cells.^{1,8} Treatment with semaglutide, a weekly injectable GLP-1 RA, results in an average of 15% change in body weight at 68 weeks.^{12,22} Liraglutide, which is injected daily, results in weight loss of 8% of total body weight at 56 weeks.²³ These medications also help address co-morbidities associated with obesity.¹² The SELECT study included 17,604 patients with obesity and cardiovascular disease and found that 2.4mg of semaglutide weekly decreased the incidence of a composite outcome of death due to cardiovascular events, non-fatal myocardial infarction, or non-fatal cerebrovascular accident (HR 0.80 95%CI 0.72–0.90).²⁴ However, there are some concerns surrounding the use of these medications. They do have notable side effects including nausea, constipation, diarrhea, headaches, fatigue, pancreatitis, and gastroparesis.^{3,25} They also require continued use to maintain their effect. An extension of the STEP 1 trial found that cessation of semaglutide after 68 weeks of treatment was associated with significant weight regain and worsening of cardiometabolic risk factors in the following year.²² The medications are also expensive and not uniformly covered by insurance. In 2022 Medicare did not cover even FDA-approved anti-obesity medications for the treatment of obesity alone.¹ An analysis by Atlas et al found that, at their current price, neither semaglutide or liraglutide are cost effective.²⁶ There is also limited availability of these medications and more data on long-term outcomes and the risks of use for the treatment of obesity are needed.¹

DISCUSSION

Both GLP-1 RAs and bariatric surgery are effective for many users; however, in direct comparison, bariatric surgery has been shown to lead to greater weight loss with at least similar improvement in co-morbidities. In 2022 Sarma and Palcu published a systematic review and meta-analysis comparing weight loss in obese adults treated with GLP-1 RAs versus bariatric surgery.⁸ Pooled analysis of 332 patients found significantly greater weight reduction in those who underwent bariatric surgery as compared to those treated with GLP-1 RAs.⁸ Their analysis also found equivalent improvement in glycemic control between the two groups, as measured by change in HbA1c at the end of the study period.⁸ However, a matched cohort study that looked specifically at patients with obesity and type II DM and compared those who had

undergone bariatric surgery with those being treated with GLP-1 RAs actually found that, at two-year follow-up, the surgery patients had a lower risk of major adverse cardiovascular events, significantly higher rates of dyslipidemia remission, and higher rates of cessation of anti-hypertensives compared to patients treated with GLP-1 RAs.²⁷ Additionally, data show that, in the long run, bariatric surgery is more cost effective than the use of anti-obesity medication.¹⁶ Despite high up-front costs, bariatric surgery has been shown to be cost effective due to its associated reduction in emergency room visits, medication use, and decrease in all cause mortality.^{16-19,28} GLP-1 RAs, however require ongoing use for continued effect. An analysis by Docimo et al found that, at current medication prices, a sleeve gastrectomy becomes more cost effective than medications after approximately a year of GLP-1 RA use and a RYGB is more cost-effective after 14 months of medication use.¹⁶ Despite the seeming ease of a medication to treat obesity and the growing popularity of GLP-1 RAs, bariatric surgery still results in more significant weight loss at a better medium-to long-term value.

Some surgeons have seen the rise of GLP-1 RAs not as a threat to bariatric surgery but as a useful adjunct. The medications can be used both pre- and post-operatively to augment the results of surgery. Pre-operatively, GLP-1 RAs have been used in very high BMI patients to prepare them for their operations. Higher pre-operative BMI (≥ 50) is associated with both higher rates of weight regain after surgery and increased peri-operative risk.^{3,12,29} A retrospective review of high BMI patients undergoing bariatric surgery found that those who were prescribed GLP-1 RAs pre-operatively lost significantly more weight while awaiting surgery compared to those who did not. There was no delay in time to surgery and no GLP-1 related complications prior to surgery.²⁹ The group who used GLP-1 RAs had a significantly higher BMI at the start of the study than those who were not taking pre-op medications, 60.7 ± 6.6 kg/m² versus 54.7 ± 3.8 ($p = 0.003$); however, there was no difference in peri-operative surgical complication rates and one third of the GLP-1 RA group were able to attain BMIs < 50 by the time of surgery.²⁹ Several other large studies have shown that pre-operative weight loss improves perioperative mortality and these data show that this can be safely achieved through treatment with GLP-1 receptor agonists.^{30,31}

GLP-1 RAs can also be used after bariatric surgery to address insufficient weight loss or weight regain. In long-term follow-up, approximately 20–30% of patients experience inadequate weight loss and up to 50% have some weight regain after undergoing bariatric procedures.^{32,33} Similarly, a meta-analysis by Yu et al found that 37% of patients will continue to have diabetes after RYGB and long-term data show a 30% risk of relapse in the 63% who do experience initial remission.³⁴ The etiology of this phenomenon is multifactorial, stemming from environmental, metabolic,

anatomic, psychosocial and nutritional influences.³ Patients with an anatomic reason for sub-optimal post-operative results often require revisional surgery but alternative treatment modalities may be needed for others in this population.

GLP-1 RAs, specifically liraglutide, have been shown to be an effective treatment for recurrent weight gain. The BARI-OPTIMISE trial investigated liraglutide as an adjunctive treatment to bariatric surgery. The study authors cite prior research showing that patients with poor post-surgical weight loss had lower circulating levels of GLP-1 compared to those with good weight loss after bariatric surgery and hypothesized that treatment with a GLP-1 RA would result in additional weight loss.³⁵ They performed a double-blind RCT including patients with sub-optimal nutrient-stimulated GLP-1 response and poor weight loss at least 12 months after sleeve gastrectomy or RYGB. Patients were treated with either 3.0 mg of liraglutide daily or a placebo in addition to recommended lifestyle interventions.³⁶ At 24 weeks, the group treated with liraglutide had significantly greater percent reduction in body weight, reduced fat mass, improved HR-QOL, and favorable changes in fasting glucose, HgbA1c, BP, cholesterol and HDL compared to the placebo group.³⁶ Another study looked at all patients with weight regain after bariatric surgery and found that, regardless of the procedure, patients who were treated post-operatively with 3.0 mg of daily liraglutide had an average of 5.5% total bodyweight loss over the 7.6 months of treatment.³⁷ The medication was fairly well tolerated with the most common side effects being nausea (37%), constipation (14.1%) and diarrhea (8.7%).³⁷ More patients discontinued the medication due to cost (35%) than adverse effects (15%).³⁷ A similar prospective study looked at all patients with weight regain after RYGB and treated them with 3.0 mg of liraglutide or a placebo. They found that 76% of the liraglutide group lost at least 5% of their body weight at 56 weeks as compared to 17% of patients in the placebo arm.³⁸ A systematic review and meta-analysis looking at three RCTs, involving 130 patients, found that treatment with liraglutide after bariatric surgery was associated with a significant decrease in BMI and body weight at six months.³⁹

The GRAVITAS trial looked specifically at treating diabetes after bariatric surgery. This was a double-blind, randomized controlled trial that included patients with persistent or recurrent type 2 diabetes after bariatric surgery.⁴⁰ They found that, when combined with a calorie-restricted diet and increased physical activity, patients treated with 1.8mg of liraglutide daily had significantly better glycemic control and significantly greater weight loss at 26 weeks than those treated with a placebo. By the end of the study period, 46% of patients treated with liraglutide lost 5% or more of their baseline bodyweight compared to only 9% of patients in the placebo group. Additionally, 42% of patients in the medication group had HbA1c levels lower than 48mmol/mol as compared to only 13% of patients treated with a placebo.⁴⁰

These results were independent of the type of bariatric surgery and the liraglutide was well tolerated with no difference in adverse events between the intervention and placebo groups.⁴⁰

CONCLUSION

Treating obesity is not simple and we are fortunate to have multiple options to offer patients. GLP-1 RAs are effective at producing weight loss up to 20% of excess bodyweight (EBW) and treating associated cardiometabolic co-morbidities. However, they are costly and require continued use for ongoing effect and long-term data on risks and outcomes are sparse. Bariatric surgery is a significant upfront commitment both in terms of cost and risk; however, it is very effective, producing an average excess body weight loss of 60%, reducing severity and even leading to remission of many comorbidities, and has long-term data showing that it is safe and confers a mortality benefit. Obesity treatment needs to be individualized and both interventions can, and undoubtedly do, have a significant role to play in this field. Despite its track record of safety and efficacy, for some patients, bariatric surgery will just not be the right option. They may have prohibitive co-morbidities, inadequate BMI, or only need short-term weight loss, in which case GLP-1 RAs are a good alternative. In many patients, the answer may be using a combination of the medications and surgery, in addition to lifestyle changes. Pre-operative use of GLP-1 RAs can lower a patient's surgical risk and increase their chances of long-term success. Post-operatively, medications can be used to augment the effects of the operation if desired results are not achieved. Ultimately, the treatment of obesity is multi-disciplinary, and the onus is on all physicians who treat affected patients to be able to effectively educate and counsel their patients about all their options.

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Authors

Eva Koeller, MD, Baystate Medical Center, Springfield, MA.
John Romanelli, MD, Baystate Medical Center, Springfield, MA;
UMass Chan Medical School, Worcester, MA.

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Correspondence

John Romanelli, MD
2 Medical Center Drive, Springfield, MA 01107
413-794-7020
John.Romanelli@baystatehealth.org

Pediatric Obesity: Practical Recommendations for Management

ARTUR CHERNOGUZ, MD, FACS

SUMMARY

The long-term negative effects of pediatric obesity necessitate a search for effective and durable treatment modalities applicable in pediatric and adolescent patients. While no unifying algorithm exists, several sophisticated management options are available. This review summarizes ways to apply available data to aid in the initial evaluation and management of pediatric and adolescent obesity.

INTRODUCTION

Pediatric and adolescent obesity remains a serious concern, affecting over 8% of children worldwide.¹ In the US, nearly 20%, or close to 15 million pediatric and adolescent patients are affected by obesity, disproportionately in low-income and minority-ethnic groups.² Stigmatized for obesity, especially from their relatives and healthcare providers, pediatric patients suffer negative effects on development and are more likely to maintain obesity in adulthood.³ Given the increasing prevalence of obesity in the pediatric population, the American Academy of Pediatrics (AAP) recently made robust recommendations for the evaluation and treatment of obesity.⁴ However, precise treatment algorithms for the escalation of care are harder to attain. Here, we examine the challenges and barriers to creating such algorithms, as well as updated data to inform practical recommendations for the treatment of pediatric obesity.

BARRIERS

One of the obstacles preventing the development of broad treatment guidelines stems from the multifactorial causes of obesity in childhood and adolescence. Genetic, social, and environmental factors are well documented and extend beyond the known genetic and syndromic causes of obesity, such as Melanocortin 4 receptor (MC4R) deficiency and Prader-Willi Syndrome.⁵ Recent advances in the understanding of underlying genetic factors and pharmacological targets have paved the way for more sophisticated treatment strategies for a small subset of patients.⁶ Nevertheless, the treatment of obesity in the adolescent population at large is associated with a unique set of challenges and nuances.^{7,8}

A growing body of evidence suggests that earlier intervention in pediatric obesity results in improved long-term

health benefits.⁹⁻¹² Despite evidence of the negative longitudinal health effects of childhood obesity, there is often a reluctance by pediatric providers to treat it with the necessary urgency. This phenomenon appears to stem from lack of familiarity with available resources and treatment options.¹³ We have previously examined the importance of pediatric providers in directing adolescent patients to consider surgical treatment as a treatment of obesity.¹⁴ However, even direct recommendations from pediatric providers appear to lead to only a small portion of patients following those recommendations.¹⁵ Nevertheless, successful treatment begins with a proactive approach and recognition that inaction or the lack of aggressive action represents a true threat to the long-term health of this population.

APPROACH TO PEDIATRIC PATIENTS

Pediatric and adolescent obesity management traditionally begins in the primary provider's office, but can also be initiated by subspecialists. Sturgiss et al propose and detail a Circular 5A model (Ask, Assess, Advise, Agree, Arrange/ Assist) to allow a longitudinal person-centered approach to supporting a patient's behavior change.¹⁶ Examining the patient's own motivation can be useful, but it often reveals a tangled web of parental and peer interactions, juxtaposed onto an evolving self-view during formative years. Wading into this territory can intimidate healthcare providers and prevent opportunities to bring obesity into the foreground of the visit. However, establishing realistic and congruent expectations among patients, their families and providers regardless of modality employed is the core of obesity treatment. When presented with treatment discussions involving metabolic and bariatric surgery, adolescents and their families face pivotal decisions. Allicock et al examined the barriers and motivations of adolescents which can be useful for providers to help address the patient-specific patients' concerns. The authors noted that patients were driven by a desire to improve their physical health, mental health, and pain-free mobility. Complementing these factors were external motivators, such as involved and supportive parents, who provided the necessary environment for successful maintenance of diet and exercise. The importance of behavior modeling was essential for navigating the peri-operative process. Fears of failure of surgery and the general risk of

undergoing a procedure were noted to be common barriers.¹⁷

However, getting a more specific assessment is challenging. When Carroll et al examined what matters to the adolescents considering surgery, they found great variability in patient perception of the right age for surgery. The patients also often viewed surgery as the last resort.¹⁸ While these observations were related to surgery, it is possible that similar themes would surround the application of pharmacotherapy, albeit to a lesser degree. Orn et al examined the views of adult patients who underwent metabolic bariatric surgery (MBS) as adolescents to inform the decision-making process. Among their experiences, emphasis was placed on the “importance of being aware that behaviors and problems related to obesity may persist after MBS.” They reinforced the need for realistic expectations regarding weight loss, recognizing the essential role of new routines, and understanding that the surgery itself would not “fix everything” in their lives. Similarly, they noted a great variability in the perception of the “right time” for surgery with some advocating for early adolescence and others wishing they had waited until their late 20s. These findings underscore the difficulty of a generalized approach and demonstrate the need for individual consideration of these patients’ journeys. They stress the importance of longitudinal family and provider support in the decision-making process.¹⁹ For instance, while a common component of initial evaluation for surgical readiness, patient education must emphasize the continued importance of mental health care, as significant mental health problems are generally not improved by surgery and weight loss.²⁰

SELECTION OF TREATMENT DECISIONS

Once the provider, patient, and family have achieved alignment regarding the need for obesity intervention, they are faced with the daunting task of selecting appropriate treatment. These decisions are best handled with a multidisciplinary approach. This is often achievable through formalized adolescent weight management programs whose providers are specifically trained and versed in discussions with adolescents and their families regarding reasonable expectations from treatment.

The traditional first approach to obesity treatment involving diet and behavior modification along with counseling yields limited results (BMI reduction ~3% over 1 year)^{5,21} Closer examination of these strategies reveals a modest effect as a stand-alone strategy. The need for extensive in-person contact, easy accessibility of appropriate dietary and exercise programs, as well as qualified behavioral specialists unfortunately makes this a relatively ineffective approach. This is even more true in adolescents with severe obesity.²² Furthermore, these programs continue to be plagued by high rates of recidivism and challenges in sustainability.²³

It is no surprise that patients and providers search for more definitive and effective measures, such as pharmacotherapy and surgery. One of the criticisms of aggressive measures in adolescence has traditionally been the lack of long-term data on the sustainability of health benefits. However, resolution of comorbidities appears to persist in available long-term surgical studies. Indeed, the long-term data is heterogeneous in the surgery groups (involving older and younger adolescents, as well as predominantly gastric sleeves or Roux-en-Y bypass procedures). However, even with those constraints, sustained weight loss in excess of 25% with meaningful and durable improvements in comorbidities are generally observed.²⁴⁻²⁷

Approved traditional pharmaceutical agents in younger patients, such as orlistat and metformin are few in number and generally limited in effect, even when combined with lifestyle interventions.^{28,29} However, the rapid integration of new classes of anti-obesity medications (AOMs) into the paradigm of obesity and Type 2 DM treatment in adults has predictably extended into pediatric treatment models. Not unlike adult prescribers, pediatric providers are blazing this trail without algorithms validated by long-term data. The available short-term and early data often guide the decision to start medications, as well as the perception that (especially older) adolescents respond to treatment in ways similar to adults.^{30,31}

Newer anti-obesity medications may provide a sought-after compromise between delay of treatment and surgery. The reversibility and substantial weight loss effects of the medications often satisfy the reluctance to acknowledge and address the need for early treatment. In fact, a recent NEJM study reported on the potential beneficial use of these medications in pre-adolescent patients.³² However, the trends in treatment modalities remain unclear. A recent analysis of MBS utilization before and after the approval of glucagon-like peptide-1 receptor agonists (GLP1-RAs) demonstrated a decrease in MBS in adults in the years 2022–2023, but an increase in adolescents in the same time period. Importantly, there was significant heterogeneity in trends among different ethnic groups, with MBS utilization increasing in the Hispanic population. The suggested explanation involves a combination of updated AAP recommendations and the improvement in MBS insurance coverage compared to that of GLP1-RAs in the studied time period.³³ The sustainability of pharmaceutical management remains uncertain. In adult literature, up to 65% of patients stop taking GLP1-RAs, which may be due to financial constraints, side-effects, or both.^{8,34} While it is yet unknown if a similar trend would be observed in adolescents, it stands to reason that over a longer time period, these medications could become one component of multipronged obesity treatment, rather than a stand-alone treatment.

SURGERY AND AOMS

The role of post-operative GLP-1 levels in creating a variable post-operative result has been suggested.^{35,36} Recently, Vidmar et al reported on the observations of post-MBS adolescents who restarted AOMs as early as three-four weeks after surgery. No significant differences in adverse events were observed and those patients who restarted their medications reported reduced hunger and emotional overeating, among other behavioral factors. Importantly, this strategy resulted in greater reduction in BMI at earlier time-points, suggesting a synergistic effect of surgery and pharmacotherapy on GLP-1 axis.³⁷

In summary, practical approaches to pediatric and adolescent obesity treatment remain a critical objective. In general, providers should focus on a sophisticated and patient-centered approach to align realistic goals and expectations with available treatments. While the treatment arsenal has become more sophisticated in recent years due to improvement in surgical and pharmaceutical approaches, a unifying algorithm for the treatment of pediatric and adolescent obesity does not yet exist. Newer anti-obesity medications will have a number of specific and off target effects, many of which could be beneficial for the treatment of obesity, addiction, and potentially mental health disorders.³⁸ Combined with surgical approaches, these treatments will likely become a mainstay of earlier intervention in adolescent obesity.

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Author

Artur Chernoguz, MD, FACS, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence RI.

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Correspondence

Artur Chernoguz, MD
2 Dudley St, Providence, RI 02903
401-228-0576
Fax 401-868-2319
achernoguz@brownhealth.org

Bariatric Surgery for Primary Care: When to Refer and How to Support Patients Pre- and Post-Surgery

ANDREW R. LUHRS, MD

ABSTRACT

OBJECTIVE: To review the primary care provider's (PCP's) role in the management of obese patients who may be candidates for metabolic and bariatric surgery, including early identification and referral, preoperative preparation, risk assessment, and long-term postoperative care. He we synthesize current guidelines and evidence to equip PCPs with practical strategies for management of metabolic and bariatric surgery patients.

KEYWORDS: Primary Care, Referral, Metabolic and Bariatric Surgery, Obesity Management

INTRODUCTION

The obesity epidemic is well documented and the rates of obesity have steadily been rising for the last several decades. According to the World Health Organization, globally obesity has nearly tripled since 1975 and one in eight people are classified as obese.¹ In the United States, the Centers for Disease Control and Prevention reports that the prevalence of adult obesity was 41.9% in 2020.² It is not surprising that with increasing prevalence of obesity that metabolic and bariatric surgery (MBS) is an increasingly utilized option for weight management and comorbidity reduction. In the United States, greater than 250,000 MBS procedures are performed annually.³ Thankfully with the advent of minimally invasive techniques and improvements in perioperative care the safety and efficacy of MBS has improved over the past two decades. In the modern era perioperative morbidity and mortality from MBS has decreased to levels comparable with other common surgeries. In fact, large-scale analyses estimate 30-day mortality rates as low as 0.1–0.3% for primary procedures, a figure that is likely to continue to improve.⁴ Beyond safety, controlled trials confirm the most superior long-term metabolic outcomes, superior to medical management alone. As compared to medical management and dieting, MBS consistently has demonstrated the greatest degree of weight loss, the most durable results, superior remission rates of obesity-related comorbidities, and improvements in all-cause mortality.^{5–7}

Despite the demonstrated efficacy of MBS, patients are often under referred by PCPs. Some studies have reported as few as 1% of eligible patients are referred for MBS.⁸ The

reasons for this are likely multifactorial and may represent a number of issues regarding access and patient-related factors. However, introspection is necessary to ensure referral patterns are not affected by implicit weight bias or misconceptions about surgery's risks and long-term outcomes, as surveys continue to reveal higher rates of weight biases and poor understanding of MBS complication rates among referring providers.^{9,10} However, with better education we may mitigate this bias and improve equitable access to care. Regardless, it remains a fact that the PCP plays a pivotal role in the early identification of patients who may benefit from bariatric surgery and will remain a vital member of the patients healthcare team throughout the weight loss journey. Additionally, lifelong support is needed to mitigate the risk of unique complications. This article aims to equip physicians with tools to manage this growing population and reviews the PCP's responsibilities in referral, preoperative preparation, risk assessment, and long-term care.

IDENTIFYING CANDIDATES FOR BARIATRIC SURGERY

BMI Criteria for Metabolic and Bariatric Surgery

MBS is currently the most effective evidence-based treatment for obesity across all body-mass index (BMI) classes. Historically, eligibility for MBS followed the 1991 National Institutes of Health (NIH) Consensus Guidelines. However, these criteria have recently been updated in response to the growing body of evidence that improvements in metabolic health can occur in patients with lower BMI after MBS.¹¹ It is important for the referring provider to understand that these shifts not only broaden eligibility to patients with lower BMIs, but also have specific considerations for Asians populations. This is due to the fact that these patients have higher cardiometabolic risk at lower BMI thresholds [Table 1]. Despite the fact that these guidelines are evidence-based, insurance coverage remains variably aligned with these newer BMI thresholds. We encourage referring providers to adhere to the more modern BMI thresholds when referring to weight loss centers.

Early Identification and Referral

Due to the high prevalence of obesity, we recommend systematic obesity screening protocols to ensure that PCPs can

Table1. Updated ASMBS/IFSO Indications for Metabolic and Bariatric Surgery

1991 NIH Consensus Guidelines	2022 ASMBS/IFSO Guidelines
BMI ≥ 40 kg/m ² with or without associated comorbidities.	BMI ≥ 35 kg/m ² with or without associated comorbidities.
BMI ≥ 35 kg/m ² with associated obesity-related comorbidity $\pm$.	BMI ≥ 30 kg/m ² with associated obesity-related comorbidity $\pm$. [‡]
	Asian populations: BMI ≥ 27.5 kg/m ²

[‡] Type 2 diabetes mellitus, Hypertension, Dyslipidemia, Obstructive sleep apnea, Non-alcoholic fatty liver disease (NAFLD), Gastroesophageal reflux disease (GERD), Osteoarthritis

identify all eligible patients and ensure they are informed about all evidence-based obesity treatment options.⁹ Essential to delivering high quality, equitable, patient-centered care is recognizing obesity as a chronic, relapsing, neuro-behavioral disease.¹² Longitudinally measuring BMI and waist circumference, and a thorough assessment of obesity-related comorbidities, is crucial for early identification of those who may benefit from intervention.¹³ When patients are identified, PCPs should initiate compassionate and nonjudgmental conversations about weight and provide the patient with education of the metabolic health benefits of the various available interventions and their impact on long-term survival.¹⁴ Emphasis should be on the fact that obesity is a chronic disease and reviewing effective treatment options, such as intensive lifestyle changes, medications, and metabolic and bariatric surgery. Structured tools may support this approach. For example, integrating the Edmonton Obesity Staging System (EOSS) and a standardized quality-of-life questionnaire into annual physicals may help stratify patients obesity and metabolic health and flag high-risk patients whose comorbidities or impaired quality of life may warrant a more prompt referral to a bariatric center.^{15,16} When patients are identified as candidates for medical or surgical weight loss they should be promptly referred to a weight loss specialist.

Psychosocial and Behavioral Readiness

Beyond lifestyle changes, successful weight loss requires a foundation of psychological stability. A routine psychological examination is generally performed by the bariatric team; however, integrating behavioral health support early in the process will enhance patient readiness, safety, and the overall appropriateness of surgical candidacy. Moreover, untreated psychiatric illness may increase postoperative complication risk and reduce adherence to care plans. For these reasons, the PCP should aim to identify patients with complicating psychosocial factors. This is best done by routine screening of mental health histories, including screening for mood disorders, post-traumatic stress disorder (PTSD), eating disorders, and prior suicide attempts. Furthermore, substance use history is equally critical and

candidates for bariatric surgery should be screened using validated tools such as AUDIT-C or the Drug Abuse Screening Test (DAST).

Contraindications to Bariatric Surgery

Not all patients will be candidates for metabolic and bariatric surgery. While there are no absolute contraindications, relative contraindications include: severe heart or lung disease, active cancer treatment, uncontrolled substance abuse, major psychiatric disorders, impaired intellectual capacity, pregnancy, Crohn's disease, multiple suicide attempts or suicidal ideation, poor adherence to preprocedural instructions, inability to manage self-care, and lack of a support system.¹⁷ We would encourage PCPs to proactively identify and address modifiable risk factors through coordinated management with weight loss specialists and other relevant clinicians to optimize surgical eligibility.

PREOPERATIVE WEIGHT LOSS

The referring provider plays a critical role in preparing patients for MBS. One of the most impactful interventions during the period between referral and the bariatric surgery evaluation is supporting preoperative weight loss. Often it can take weeks to months for the initial visit with a surgeon to occur and this offers an ideal opportunity to begin documented counseling on weight reduction goals and strategies. Moreover, many insurance providers require a number of months of documented weight loss discussions either in the PCPs office or in the bariatric surgeons office. Starting this process sooner helps set realistic expectations, reinforces the importance of lifestyle change, and ensures more rapid progression through the evaluation for MBS.

Additionally, preoperative weight loss can improve perioperative and postoperative outcomes, as it has been shown that decreasing liver volume and visceral fat, facilitates laparoscopic access and reduces operative time and conversion to open rates.^{18,19} Additionally, while not required in most centers, preoperative weight loss may also serve as a practical test of patient compliance and readiness.²⁰ Primary care providers can support these goals through evidence-based interventions such as high protein, low carbohydrate diets, pharmacotherapy with GLP-1 receptor agonists such as semaglutide or tirzepatide, and structured behavioral counseling. Proactively addressing weight loss in primary care also ensures patients feel supported throughout the preoperative process and lays the groundwork for lifelong behavioral change.

POSTOPERATIVE AND LONG-TERM FOLLOW-UP CARE

Immediate Postoperative Phase

The first six months following bariatric surgery represent

a critical period and requires coordinated care between the bariatric surgeon and the PCP. Patients are going through rapid physiological change in addition to recovering from surgery. The primary goal in this phase is to monitor for early postoperative complications; such as, anastomotic leaks, thromboembolic events, bleeding, or infections. Beyond monitoring for surgical complications, nutrition management involves a protocolized dietary progression. Patients are generally advanced from a clear liquid diet to purees, soft solids, and eventually regular textured foods. Dietary counseling should include education on portion control and hydration. Patients should be advised to avoid high-sugar foods to prevent dumping syndrome. Finally, careful attention to patients' medication regimen is vital. With substantial weight loss and metabolic improvements, it is frequently necessary to adjust or discontinue of medications for obesity-related comorbidities. While patients will be closely monitored by the bariatric surgery team, close communication enhances safety during this period.

Nutritional Surveillance and Management

Although bariatric centers typically conduct intensive follow-up during the first one to two years postoperatively, responsibility for ongoing micronutrient surveillance often transitions to the primary care provider thereafter. Lifelong supplementation with a bariatric-specific multivitamins and routine annual vitamin and micronutrient labs are mandatory [Table 2]. Guidelines recommend routine assessment of key nutrients annually, given the persistent risk of deficiencies even years after surgery.¹⁷ Primary care physicians should be familiar with these monitoring protocols and ensure adherence to lifelong supplementation regimens to prevent serious complications such as anemia, neuropathy, osteoporosis, and neurologic syndromes.

Weight Regain: Detection and Management

Despite the substantial and sustained weight loss achieved by most patients after bariatric surgery, up to 30% may experience clinically significant weight regain.^{17,21} Patients with a history of MBS should be screened annually to identify early signs of weight regain and implement interventions. Contributing factors include poor dietary habits, sedentary behavior, and anatomical changes over time, such as dilation of the gastric sleeve or the formation of a gastro-gastric fistula. Typically, management begins reinforcement of nutritional and behavioral strategies. If unsuccessful, pharmacologic therapies such as GLP-1 receptor agonists and other anti-obesity medications can be considered; however, for patients with significant regain, referral back to the bariatric surgeon is required to rule out an anatomical reason for weight recidivism and to discuss surgical if revision is indicated.

Psychosocial Considerations

The psychosocial dimension of bariatric surgery is critical to long-term management of these patients. Patients often face profound identity changes, emotional volatility, and risk for disordered eating, including binge eating or "transfer addiction" to substances such as alcohol or drugs.^{22,23} Therefore, it is recommended that routine screening for depression, anxiety, and maladaptive eating behaviors be performed annually to ensure early detection and intervention. Additionally, PCPs should facilitate access to support groups (often available through the bariatric surgery center), behavioral health professionals, and specialized counseling services that can provide coping strategies and reinforce the patient's commitment to lifestyle changes. Regular motivational counseling in the primary care setting can help sustain behavioral modifications, prevent relapse into unhealthy patterns, and promote emotional resilience.

Table 2. Recommended Long-Term Micronutrient Screening After Bariatric Surgery

Nutrient	Monitoring	Common Deficiency Symptoms
Thiamine (B1)	Every 6–12 months	Wernicke's encephalopathy (confusion, ataxia, ophthalmoplegia)
Vitamin B12	Every 6–12 months	Fatigue, neuropathy, glossitis
Iron	Every 6–12 months	Anemia, pica
Calcium/Vitamin D	Annually	Osteopenia, secondary hyperparathyroidism, fractures
Folate	Annually	Anemia, neural tube defects in pregnancy
Protein	Annually	Edema, weakness, muscle wasting
Vitamin A	Annually	Night blindness, xerophthalmia, impaired immunity
Vitamin E	As indicated	Neuropathy, ataxia, hemolytic anemia
Vitamin K	As indicated	Easy bruising, bleeding diathesis
Copper	Annually	Anemia, neutropenia, neuropathy, myelopathy
Zinc	Annually	Dermatitis, alopecia, impaired wound healing, taste changes

Special Populations

Certain patient groups require tailored counseling and management to ensure safe and effective outcomes after bariatric surgery. Women of childbearing age should be advised to delay pregnancy for 12–18 months postoperatively to avoid pregnancy complications derived from nutrient deficiencies or rapid weight loss.²⁴ For those planning pregnancy after surgery, prenatal care must include micronutrient surveillance with particular attention to iron, folate, vitamin B12, calcium, and fat-soluble vitamins. In older adults, bariatric surgery can improve metabolic health and functional status but requires careful risk-benefit assessment due to higher perioperative risks, sarcopenia concerns, and the

potential for nutritional deficiencies exacerbated by age-related changes in absorption and bone health.

CONCLUSION

Bariatric surgery is a proven, effective intervention for the management of severe obesity and its associated comorbidities, offering patients meaningful and sustained weight loss, improved metabolic health, and reduced mortality. However, it is not a stand-alone cure, but rather one component of a lifelong, multidisciplinary treatment plan that requires ongoing commitment from patients and providers alike. PCPs play a central role in this continuum of care from early identification and referral of appropriate candidates, to preoperative optimization, to vigilant long-term monitoring for nutritional deficiencies, weight regain, and psychosocial challenges. By adopting structured screening protocols, fostering empathetic, stigma-free discussions about obesity as a chronic disease, and collaborating closely with surgical, nutritional, and behavioral health teams, PCPs can help ensure that patients derive the full benefits of bariatric surgery while minimizing risks.

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Author

Andrew R. Luhrs, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

Disclosures

Andrew Luhrs serves as a consultant for BD, Intuitive, and Medtronic.

Correspondence

Andrew R. Luhrs, MD
195 Collyer St, Suite 302, Providence, RI 02904
401-793-5701
Fax 401-793-5171
ALuhrs@brownhealth.org

Endoscopic Therapeutics for the Management of Obesity

EMILY ORTEGA GODDARD, MD

ABSTRACT

BACKGROUND: Obesity is a chronic, multifactorial disease associated with significant comorbidities and rising global prevalence. Lifestyle interventions alone often fail to achieve sufficient or durable weight loss, while pharmacologic and surgical therapies face limitations in cost, access, or patient acceptance.

OBJECTIVE: To review the role of endoscopic bariatric and metabolic therapies (EBMTs) in the management of obesity, highlighting efficacy, safety, and clinical applications.

METHODS: A narrative review of current EBMTs, including intragastric balloons (IGBs), endoscopic sleeve gastroplasty (ESG), duodenal mucosal resurfacing (DMR), and duodenal-jejunal bypass liners, with emphasis on FDA-approved and investigational devices.

RESULTS: IGBs achieve 7–14% total body weight loss but are temporary and limited by tolerability. ESG provides 15–25% weight loss as a durable, minimally invasive alternative to surgery, with some metabolic benefits. DMR improves glycemic control in type 2 diabetes with modest weight loss effects. Duodenal-jejunal bypass liners demonstrate weight loss and HbA1c reduction but remain investigational due to device migration and safety concerns.

CONCLUSIONS: EBMTs bridge the treatment gap between lifestyle, pharmacologic, and surgical options. They offer safe, minimally invasive, and effective strategies for weight loss and metabolic improvement, expanding access to obesity care.

KEYWORDS: Obesity, Endoscopic bariatric and metabolic therapies, Intragastric balloon, Endoscopic sleeve gastroplasty, Duodenal mucosal resurfacing, Duodenal-jejunal bypass liner

INTRODUCTION

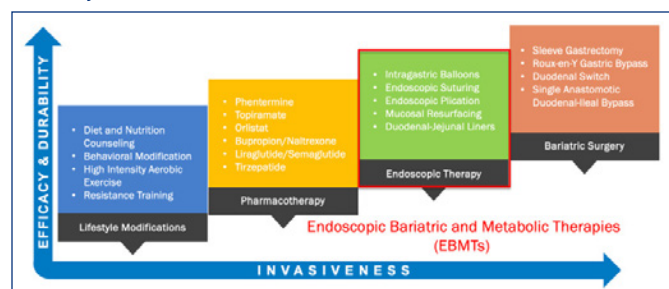
Obesity rates continue to rise worldwide. According to the World Health Organization (WHO), as of 2022, one in eight adults were living with obesity – a rate that has more than doubled since 1990.¹ The disease of obesity is associated

with a host of other diseases including hypertension, hyperlipidemia, diabetes, coronary artery disease, and obstructive sleep apnea, which can lead to further cardiac disease.² When defined by a BMI greater than or equal to 30, the prevalence of obesity among adults in the United States was 40.3%.³ While diet and increased activity are the backbone of any successful weight-loss regimen, they alone are often not enough to lose a significant amount of weight and keep it off in the long-term. In a meta-analysis of 29 long-term weight loss studies, most of the weight lost was regained within two years.⁴ Diet and exercise do work, but often they are not powerful enough for advanced stages of obesity. A patient with a BMI of 40 would need to lose 15 BMI points to be within the health BMI range (18.5–24.9). This 15 point weight loss would be 37.5% weight loss, which is a very large number. Many studies illustrate success with diet and exercise are losing far less weight than many truly need, around 3–10%.

To really combat the disease of obesity and the plethora of harmful risks that come along with it, we need to increase the amount of weight loss patients achieve and increase the durability of that weight loss. There are now many tools to amplify weight loss and treat obesity, including pharmacotherapies, endoscopic therapies, and surgical therapies. We have seen enormous success seen with the glucagon-like peptide 1 and dual GLP-1/glucose-dependent insulinotropic polypeptide (GIP) receptor agonists; however, their success is limited due to expense, uncertain reimbursement rates, and weight regain with cessation of the medications. On the flip side, many patients may perceive weight loss surgery as dangerous. To bridge this gap, endoscopic therapies for the treatment of obesity have become more popular due to their success and safety profiles. Endoscopy is performed through the mouth and the complication rates are very low. This category of therapies is procedure-based and ultra-minimally invasive, allowing us to reach more patients in a less invasive way.⁵

Endoscopic bariatrics and metabolic therapies (EBMTs) can be the primary treatment option for patients with obesity or may serve as a treatment option for weight regain after bariatric surgery.⁶ There are many types of endoscopic procedures for weight loss worldwide, with a handful being approved by the US Food and Drug Administration (FDA). The main categories of endoscopic therapies for weight loss

Figure 1. Obesity treatments in order of advanced invasiveness and durability.



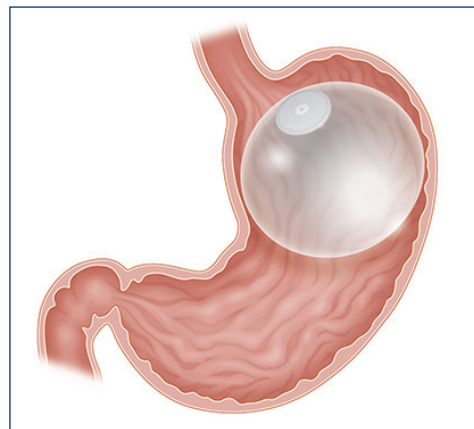
Allencherril, R. P., & McCarty, T. R. (2025). Strategies to Manage Obesity: Endoscopic Bariatric and Metabolic Therapies. *Methodist DeBakey cardiovascular journal*, 21(2), 74–83. <https://doi.org/10.14797/mdcvj.1518>

management are Intragastric Balloons (IGBs), endoscopic suturing techniques such as endoscopic sleeve gastrectomy (ESGs), duodenal mucosal resurfacing, and duodenal-jejunal bypass liner (endobarrier). All these therapies can be used as a primary treatment in patients with Class 1 obesity (BMI >30) or higher, who do not wish to undergo bariatric surgery, who are poor surgical candidates, or who do not wish to use pharmacotherapy for a long duration of time [Figure 1].

Intragastric Balloons (IGBs)

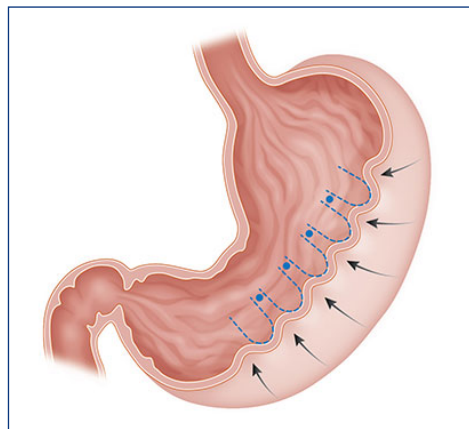
Intragastric balloons (IGBs) are endoscopically placed devices that occupy space within the stomach [Figure 2]. They work by limiting the volume of food that can occupy the stomach and are generally categorized as restrictive in their function by reducing oral intake. IGBs lead to early feelings of fullness or early satiety, and staying full for longer, also known as delayed gastric emptying. They can be placed as an outpatient endoscopic procedure, meaning the patient comes in, undergoes the endoscopic placement, and goes home the same day. There are multiple types of IGBs on the

Figure 2. Intragastric balloon weight loss procedure – Brigham and Women's Hospital.



<https://www.brighamandwomens.org/cwmw/intragastric-balloon-weight-loss-procedure>

Figure 3. Endoscopic Sleeve Gastropasty – Brigham and Women's Hospital.



<https://www.brighamandwomens.org/cwmw/endoscopic-sleeve-gastropasty>

market, but only a few approved in the US by the FDA. Most of the current balloons are inserted into the stomach and then insufflated with sterile water, saline, or air. The volume of fluid placed within the balloons varies by manufacturing and by patient – how well they tolerate the volume, their symptoms, and their weight loss goals. The balloon is left in place within the stomach for 4–12 months. The benefits of this procedure are that it can be easily placed and removed, can lead to 7–14% total weight loss,⁷ and can be widely adopted. Disadvantages include how well it is tolerated – some patients report significant nausea or other related unwanted symptoms, durability as it is temporary and must be removed, and side effects such as the balloons popping and migrating. This endoscopic weight loss modality is only currently recommended as a primary treatment and not in patients who have had previous foregut or bariatric surgery. Compared with lifestyle modifications alone such as diet and exercise, these IGBs are more effective at short-term weight loss, with some studies illustrating 25% excess weight loss (EWL).⁸ All in all, this is a great option for patients who want more powerful weight loss and improvement in comorbidities than weight loss and exercise alone, with a short duration in therapy.

Endoscopic Sleeve Gastrectomy

This is a procedure that uses endoscopic suturing to plicate the stomach from the inside, meaning sewing it from the inside down into a smaller pouch. Using a special endoscopic instrument, the apollo overstitch, circumferential bites of stomach lining or gastric mucosa are taken and synched down [Figure 3]. This works as a weight loss tool in a similar way to the balloons – the suturing of the stomach from the inside makes the stomach much smaller, limiting the amount of food one can eat at a given time and increasing the sensation of fullness. As most of the other endoscopic procedures, this is often

a same-day procedure, where the patient can come into the endoscopy suite or operating room, has the endoscopic sleeve created, and go home the same day. An ESG is considered semi-permanent with restriction effects that can last, and a version of this technique can be performed in patients who've had previous foregut or bariatric surgery. However, some of the sutures can open over-time, leading to an increase in size of the stomach again, so it is surely not as permanent or durable as its sister surgical option, the sleeve gastrectomy.

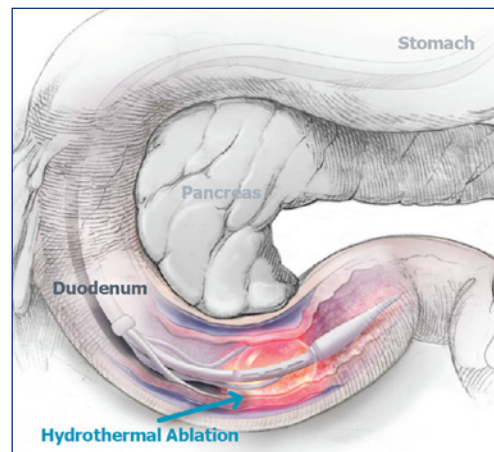
Total weight loss has been measured from 15–25% in literature when performed as a primary procedure. The MERIT trial illustrated great efficacy of ESG compared to lifestyle modifications and these results were durable.⁹ At 52 weeks, 80% of patients who underwent an ESG has improvement in one or more of their comorbidities. At two years, 68% maintained 25% or more of their EWL. Another study illustrated 17.6% and 20.9% total weight loss at 12 and 24 months after the ESG,¹⁰ proving it to be a pretty powerful and semi-durable treatment tool. Besides not being completely permanent, it also is a relatively complex procedure, more so than balloon placement, so that does limit the ESGs overall availability and widespread use. Despite the hefty learning curve, endoscopic suturing is by far the most widely used endoscopic bariatric and metabolic therapy in the United States. As a primary, stand-alone procedure, the ESG can provide significant weight loss and improvement in comorbidities such as diabetes, blood pressure, and hypertriglycerides.¹⁰

Endoscopic suturing may also be used to achieve weight loss after previous surgery has already been performed, such as after a laparoscopic sleeve or bypass. Multiple post-surgical anatomic findings have been linked to weight regain after bariatric surgery, such as retained fundus or stretching of the sleeve after a sleeve gastrectomy, or an enlarged gastric pouch or enlarged gastrojejunal anastomosis after surgical gastric bypass. In all of these scenarios, endoscopic suturing may be used to suture the spaces from the inside, making them smaller and more restrictive, leading to decreased intake and weight loss. Studies have demonstrated, however, that primary endoscopic procedures have more successful weight loss than revisional procedures, with a TWL of 8–12% seen with revisional procedures.⁶

Duodenal Mucosal Resurfacing (DMR)

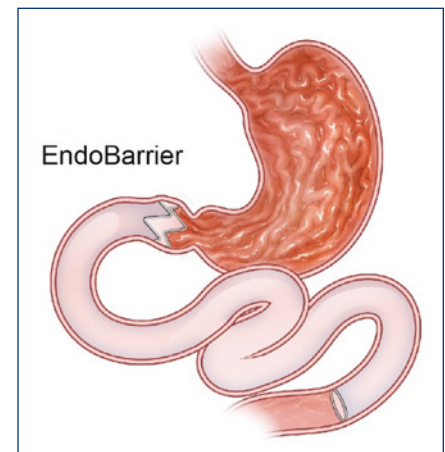
This procedure is not yet FDA-approved but is being performed at some large centers throughout the country and even here in the New England area. In this procedure, the first part of the small intestine, the duodenum, is the target of therapy. The inner lining of the duodenum, or the mucosa, is ablated to improve insulin sensitivity and aid in weight loss [Figure 4]. This procedure is performed as a one-time treatment, with some centers performing it same day and others requiring a brief post-procedure stay. Although still under investigation, early results indicate promising

Figure 4. Duodenal mucosal resurfacing.



Hoyt JA, Cozzi E, D'Alessio DA, Thompson CC, Aroda VR. A look at duodenal mucosal resurfacing: Rationale for targeting the duodenum in type 2 diabetes. *Diabetes Obes Metab.* 2024; 26(6): 2017–2028. doi:10.1111/dom.15533

Figure 5. EndoBarrier.



McCarty TR, Thompson CC. The current state of bariatric endoscopy. *Dig Endosc.* 2021;33:321–34

outcomes, with several studies illustrating improved glycemic control and insulin sensitivity. HbA1c was reported to have improved by 1.2%.^{11,12} This procedure is mostly focused on the obesity-related comorbidity of diabetes, seeking to improve the condition in poorly controlled diabetes, and not so much a tool for weight loss. The reported weight loss is 2–8% total weight loss and considered modest, aligning with changes seen with lifestyle modifications alone. Overall, DMR may be a useful tool for diabetes management, but more data is needed to better understand the durability and efficacy of the treatment.

Duodenal-jejunal Bypass Liner (RESET or EndoBarrier)

This device is another investigational device that acts as an endoscopic bypass. The device is a 60cm long fluoropolymer liner that lines the intestines and blocks them from absorbing nutrients, leading to improved glycemic control and weight loss [Figure 5]. The liner is placed endoscopically under direct vision and with the aid of fluoroscopy with the hopes that it stays in place for one year. Early studies have illustrated improvement in HbA1c.¹³ In a study from Brigham and Women's, the bypass liner was found to demonstrate an average decrease in BMI by about four points, and 18.9 % total body weight loss.¹⁴ The intestines are designed to push food forward, eventually ending in the large intestine, the colon, and leaving the body in the form of stool. In these studies, the bypass liner device did sometimes do just that – it migrated downstream, and needing to be removed early in some patients. All things considered, this device requires more studies and data before it becomes approved and readily available as a weight loss and commodity management tool.

CONCLUSION

Many endoscopic therapies are out there for the treatment of obesity and its related comorbidities. These options have demonstrated success in both treatment naïve patient and those with a history of previous foregut or weight loss surgery. All of these endoscopic procedures provide longer lasting weight loss and, in some cases, more durable glycemic control than medications or lifestyle medications alone.

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Author

Emily Ortega Goddard, MD, Department of Surgery, Penn State Health Milton S. Hershey Medical Center, Hershey, PA.

Disclosures

The author has no disclosures.

Correspondence

Emily Ortega Goddard, MD
Department of Surgery
Penn State Health, Milton S. Hershey Medical Center
500 University Drive, M.C. H149, Hershey, PA 17033
717-531-7462
Fax 717-531-4729
egoddard@pennstatehealth.psu.edu

Preoperative Aprepitant Decreases Postoperative Nausea After Laparoscopic Sleeve Gastrectomy

WESLEY THORNE, MD; DENIS SNEGOVSKIKH, MD; MARCOANDREA GIORGI, MD; ANDREW R. LUHRS, MD; TODD S. STAFFORD, MD; KELLIE ARMSTRONG, MSN, RN; BETH A. RYDER, MD

ABSTRACT

BACKGROUND: Postoperative nausea is common following bariatric surgery despite the use of enhanced recovery protocols for perioperative care.

OBJECTIVES:

- To determine the prevalence of postoperative nausea in our sleeve gastrectomy population.
- To administer preoperative aprepitant and track postoperative nausea after laparoscopic sleeve gastrectomy.

METHODS: Beginning in September 2022, a retrospective cohort study was conducted. We added 80 mg of oral aprepitant to a standard prophylactic antiemetic regimen, which included scopolamine, dexamethasone, and ondansetron. Utilizing an existing database at our institution, we reviewed the records of patients who underwent laparoscopic sleeve gastrectomy before and after the addition of aprepitant to the standard prophylactic antiemetic regimen. We assessed the severity and frequency of postoperative nausea and vomiting qualitatively (endorsed in postoperative-day-one house-staff note) and quantitatively (number of postoperative antiemetic doses administered beyond standard protocol).

RESULTS: One hundred thirty-four (134) laparoscopic sleeve gastrectomies were performed between March and November 2022. Sixty-four patients (64) received aprepitant preoperatively, while 70 did not. Groups were similar in age, BMI, and ASA class. In the aprepitant group, we noted a 41.60% reduction in nausea reported on postoperative-day-one (29.20% vs 50.00%, $P=0.013$) and a 30.5% reduction in absolute number of additional antiemetic doses (2.98 vs 4.29, $P=0.013$). Additional antiemetics included ondansetron, metoclopramide, prochlorperazine, diphenhydramine, haloperidol, and lorazepam. Length of stay was not significantly different.

CONCLUSIONS: The addition of preoperative aprepitant to a multimodal protocol can reduce nausea after laparoscopic sleeve gastrectomy.

KEYWORDS: Aprepitant, Postoperative Nausea and Vomiting (PONV), Bariatric Surgery, Enhanced Recovery After Surgery (ERAS)

INTRODUCTION

Postoperative nausea and vomiting (PONV) is a major cause of patient dissatisfaction with perioperative care.¹⁻³ It contributes to a variety of postoperative problems, including delayed oral intake, dehydration, electrolyte abnormalities, aspiration, and increased length of hospital stay.^{3-5,9} The incidence of PONV is common following bariatric surgery.^{3,5,8,9}

To decrease the risk of PONV among bariatric patients, our institution's enhanced recovery protocols for surgery (ERAS) includes a standard prophylactic antiemetic regimen for every patient. While our ERAS protocol has been effective in reducing PONV among laparoscopic gastric bypass patients, we observed many laparoscopic sleeve gastrectomy patients continued to experience significant PONV. To better define and address this problem, our surgical team partnered with anesthesiology to refine our ERAS protocol for laparoscopic sleeve gastrectomy patients.

Based on existing data demonstrating the efficacy of aprepitant as an antiemetic, we added the medication to our ERAS regimen. Aprepitant is a long-acting neurokinin-1 (NK-1) receptor antagonist without sedative effect or risk of tardive dyskinesia and has been approved by the FDA for the prophylaxis of chemotherapy-related nausea and PONV.⁶ Several studies and meta-analyses have demonstrated its efficacy as a prophylactic agent to reduce PONV, though none have focused specifically on laparoscopic sleeve gastrectomy.^{3,5,7}

In our study, we assess the efficacy of adding prophylactic aprepitant to an existing ERAS protocol for the prevention of PONV after laparoscopic sleeve gastrectomy.

METHODS

With appropriate Institutional Research Board (IRB) approval, a retrospective cohort study was conducted, including all patients who underwent laparoscopic sleeve gastrectomy from March 2022 to November 2022 at our institution. All patients received a pre-existing, standardized prophylactic antiemetic regimen, which included preoperative scopolamine patch placed the day prior to surgery, a single dose of intra-operative dexamethasone, and 24 hours of standing postoperative ondansetron. Beginning September 2022, 80 mg oral aprepitant administered three hours prior to induction of anesthesia was added to the standard prophylactic antiemetic regimen.

Utilizing a pre-existing, quality improvement database within the Center for Bariatric Surgery, the records of all patients who underwent laparoscopic sleeve gastrectomy between March 2022 and November 2022 were reviewed. Variables already included in the pre-existing database included medical record number (MRN), patient age, body mass index (BMI), American Society of Anesthesiologists Physical Status Classification (ASA I-VI), date of surgery, discharge date, and length of stay (LOS) as measured in days. Additional variables collected from the electronic medical record of each patient included documentation of preoperative scopolamine patch application, time of aprepitant administration, number of postoperative antiemetic doses administered in addition to the standard prophylactic regimen, and documentation of nausea as subjectively reported on postoperative-day one (POD#1).

To determine whether a scopolamine patch was applied preoperatively, each patient's medication dispense report was queried and peri-anesthesia nursing notes reviewed. Patients who received a prescription for scopolamine prior to surgery, or those who had a scopolamine patch applied in preoperative holding, were considered to have received the medication unless nursing notes documented otherwise. The application of a scopolamine patch at any time on the day of surgery, regardless of whether the patient had applied one previously, was not considered an additional antiemetic dose.

Time of aprepitant administration as documented in a patient's medication administration record (MAR) was used to determine if a patient received aprepitant preoperatively, postoperatively, or both. Patients who received aprepitant preoperatively were included in the aprepitant group, while those who did not were included in the control group. Postoperative administration of aprepitant was considered an additional antiemetic dose, regardless of whether the patient received aprepitant preoperatively or not.

The total number of antiemetic doses administered beyond the standard prophylactic regimen was determined by reviewing each patient's MAR. Any postoperative antiemetic administered, other than 24 hours of standing ondansetron as included in the standard prophylactic regimen, was considered an additional dose, whether it was ordered as needed or as a one-time dose. A medication was considered to be an antiemetic if it was ordered with an indication of nausea or vomiting. Any medication commonly used to treat postoperative nausea, unless ordered with a different specified indication, was also included. Antiemetics included ondansetron, metoclopramide, prochlorperazine, diphenhydramine, haloperidol, and lorazepam.

Reported postoperative nausea was determined by reviewing POD#1 notes from resident and attending physicians, nutritionists, and nurses. Any documented complaint of nausea or emesis, including those noted to be "minimal," "controlled," "improving," or "resolved," was considered to

represent clinically significant postoperative nausea. If there was no mention of nausea or emesis in any notes, the patient was considered not to have clinically significant postoperative nausea.

Statistical Analysis

Statistical analysis was performed using STATA Version 15 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC). Two groups were compared – those who received preoperative aprepitant (aprepitant group) and those who did not (control group). Demographic data between groups was compared using Student's two-sample *t*-test (age, BMI) and Pearson's chi-squared test (ASA). Wilcoxon rank sum test was used to compare LOS and number of additional antiemetic doses, while Pearson's chi-squared test was used to compare rates of reported POD#1 nausea between groups.

RESULTS

One hundred thirty-four (134) laparoscopic sleeve gastrectomies were performed between March and November 2022. Sixty-four (64) patients received aprepitant preoperatively (aprepitant group), while 70 did not (control group). Other than one 17-year-old patient (BMI 50 kg/m²), all patients were adults ages 18-69 years old with a mean BMI of 43.6 kg/m² [34–64 kg/m²]. On statistical analysis, groups were similar in age, BMI, and ASA class [Table 1].

Clinically significant nausea was reported on POD#1 by 29.2% (19/64) of patients who received aprepitant, and 50.0% (35/70) of those who did not (*p*=0.013). This represented a 41.60% relative reduction in reported PONV on POD#1 in the aprepitant group. The mean number of antiemetic doses required in addition to the standard prophylactic regimen was 2.98 [1–20] in those who received aprepitant preoperatively, compared to 4.29 [1–28] in those who did not (*p*= 0.0027). This represented a 30.5% relative reduction in unplanned postoperative antiemetic doses in the aprepitant group. There was no significant difference in length of stay between groups, which both had a median LOS of 1 day

Table 1. Demographics, Reported Nausea, and Number of Additional Antiemetic Doses

	Control (n=70)	Aprepitant (n=64)	P-value
Age (years)	39.31	41.59	0.2506
BMI (kg/m ²)	43.89	43.27	0.5708
Median ASA	3	3	0.410
Median LOS	1	1	0.6348
POD#1 nausea	50.00%	29.20%	0.013
Antiemetic doses	4.29	2.98	0.0027

BMI=body mass index. ASA=American Society of Anesthesiologists Physical Status Classification. LOS=length of stay. POD#1=postoperative day 1. Antiemetic doses=unplanned doses of antiemetics beyond standard prophylactic regimen.

($p=0.6348$). LOS ranged from one to three days in the aprepitant group, and one to four days in the control group.

Of the 70 patients who did not receive aprepitant preoperatively, 15 received the medication postoperatively. This subset of control group patients required more antiemetic doses than either the aprepitant group or the remainder of the control groups, with a mean of 9.8 [4–28] additional antiemetic doses. Two patients in the aprepitant group received a second dose of aprepitant on POD#1, which was included as an additional antiemetic dose beyond the prophylactic regimen. One of these patients required a total of three additional antiemetic doses, while the other required a total of 20.

DISCUSSION

The addition of preoperative aprepitant to an existing ERAS protocol for the prevention of PONV after laparoscopic sleeve gastrectomy proved to be effective in reducing PONV both quantitatively and qualitatively when compared to the existing ERAS protocol alone. Compared to the control group, patients who received prophylactic aprepitant required fewer additional antiemetic doses (2.98 vs 4.29, $p=0.0027$) and reported less nausea/vomiting on POD#1 (29.2% vs 40.0%, $p=0.013$). While these results are consistent with previous studies demonstrating the efficacy of aprepitant as a prophylactic antiemetic for patients undergoing bariatric surgery, they suggest the medication's efficacy is more pronounced following laparoscopic sleeve gastrectomy as opposed to other types of bariatric surgery.

Two prior studies have demonstrated aprepitant's prophylactic efficacy in reducing emesis after bariatric surgery, though both studies included predominantly gastric bypass patients, and neither study demonstrated a reduction in patient-reported nausea.^{3,5} Sinha et al performed a double-blind, placebo-controlled study of 125 participants undergoing bariatric surgery, 98 (79%) of whom underwent a bypass procedure, while the remaining 26 underwent gastric banding. Compared to the placebo group, those who received prophylactic aprepitant had a significantly lower rate of emesis at 72 hours (3.1% vs 15.0%, $p=0.021$), though verbal rating scores of nausea were no different between groups ($p=0.675$).³ Therneau et al performed a retrospective analysis of 338 patients undergoing bariatric surgery, 257 (76%) of whom underwent malabsorptive procedures, while 62 underwent sleeve gastrectomy and 19 underwent gastric banding. Compared to the control group, there was a lower cumulative incidence of emesis in the aprepitant group over 48 hours (6% vs 13%, $p=0.04$), though there was no difference in reported nausea or additional antiemetics required.⁵

While we did not quantify cumulative episodes of emesis, our study demonstrated a significant reduction in both patient-reported nausea/vomiting and antiemetic doses required. This finding suggests that laparoscopic sleeve

gastrectomy patients benefit from prophylactic aprepitant for the prevention of PONV more than those undergoing other types of bariatric surgery. Following completion of our project, these findings have been replicated in a randomized controlled trial performed by Ortiz et al.¹⁰ This group demonstrated improvement in PONV over the first 24 hours postoperatively after laparoscopic sleeve gastrectomy using a validated assessment scale.

There are several proposed mechanisms for why sleeve gastrectomy patients have increased rates of PONV. This may be due to anatomy, with the pylorus remaining intact and the stomach unable to distend after sleeve gastrectomy is performed, leading to overdistension with smaller amounts of intraluminal contents. Removal of the gastric fundus and its stretch receptors may temporarily slow gastric emptying immediately after surgery. It is also known that enterochromaffin cells release 5-hydroxytryptamine in response to gastric surgery. This hormone is associated with nausea and vomiting and appears to have a greater effect on the obese population.⁸

Limitations

It is important to note that our assessment of subjective nausea was restrained by the limitations of a retrospective study design – no standardized or validated tool was used to assess nausea. Rather, we relied on documentation from various providers in the electronic medical record of each patient. While this heterogeneity lends some degree of uncertainty to our findings, the relative reduction in reported nausea/vomiting (41.6% RRR) and antiemetic dose requirement (30.5% RRR) were similar. Because antiemetics were ordered as PRN or one-time doses with an indication of nausea, a patient's antiemetic requirement can be assumed to be a reasonable proxy for subjective nausea, and our data adequately reliable.

CONCLUSION

PONV is a prevalent problem after laparoscopic sleeve gastrectomy. The addition of preoperative aprepitant to an existing ERAS protocol is effective in reducing PONV. Patients undergoing this procedure appear to benefit more from the prophylactic antiemetic effects of aprepitant than those undergoing other bariatric surgeries (e.g., gastric bypass) based on comparison with previous studies.^{3,5,10} Our results were limited by heterogeneous documentation of subjective nausea, though appear to be reliable based on concordance between reported nausea/vomiting and number of antiemetic doses required. Future research should work on treatment options for non-responders, those patients with persistent nausea despite use of our current protocols.

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Authors

- Wesley Thorne, MD, Warren Alpert Medical School of Brown University, Providence, RI.
- Denis Snegovskikh, MD, University Anesthesiologists, Rush University, Chicago, IL.
- Marcoandrea Giorgi, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.
- Andrew R. Luhrs, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.
- Todd S. Stafford, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.
- Kellie Armstrong, MSN, RN, The Miriam Hospital; Brown University Health, Providence, RI.
- Beth A. Ryder, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

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- Andrew Luhrs serves as a consultant for BD, Intuitive, and Medtronic.
- Marcoandrea Giorgi serves as a consultant for BD.

Correspondence

- Beth Ryder, MD
195 Collyer St., Suite 302, Providence, RI 02904
401-793-5701
Fax 401-793-5171
bryder@brownhealth.org

Contained Leak Following Laparoscopic Sleeve Gastrectomy: Successful Management with Endoscopic Wound Vacuum Therapy and Stenting

CODY NESS, MD; MARCOANDREA GIORGI, MD; ANDREW R. LUHRS, MD

ABSTRACT

We report the case of a 32-year-old male with a history of hypertension and obesity who developed perigastric abscess and staple line dehiscence two weeks after undergoing laparoscopic sleeve gastrectomy, consistent with a contained staple line leak. The patient presented with fever, abdominal pain, and imaging-confirmed abscess at the gastric cardia. Management included multiple endoscopic wound vacuum exchanges, eventual esophagogastric stent placement, and nutritional support. The case demonstrates a multidisciplinary approach to a complex post-bariatric surgery complication, highlighting the role of advanced endoscopic therapies in avoiding open surgical re-intervention.

INTRODUCTION

Laparoscopic sleeve gastrectomy is a widely used bariatric procedure with generally favorable outcomes. However, staple line leaks remain one of its most serious complications. Traditional management has included surgical drainage or re-operation, but endoscopic therapies, such as endoluminal wound vacuum systems and stenting, are increasingly employed to achieve source control and promote healing in carefully selected patients.

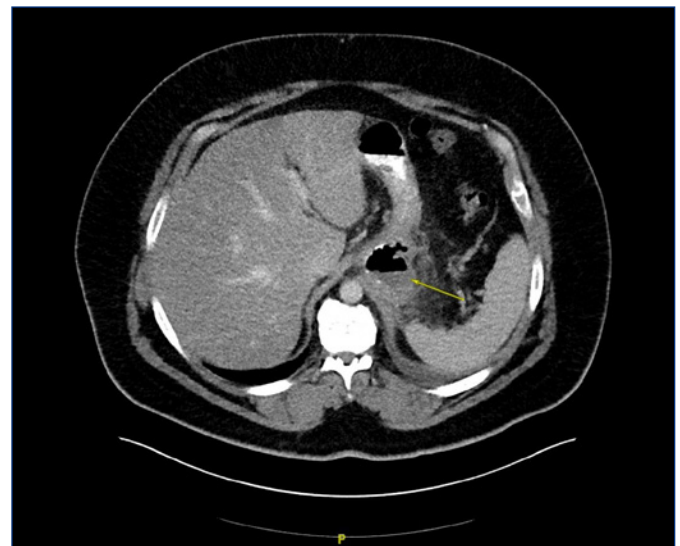
CASE PRESENTATION

A 32-year-old male with a medical history of hypertension and morbid obesity presented with three days of worsening epigastric pain, fever, chills, and decreased appetite approximately 14 days after undergoing an uncomplicated laparoscopic sleeve gastrectomy at an outside hospital. On presentation, the patient was awake, alert, and in no acute distress. Vital signs were notable for a temperature of 100.8 °F, heart rate of 108 beats per minute, blood pressure of 148/88 mm Hg, respiratory rate of 16 breaths per minute, and oxygen saturation of 97% on room air. The abdominal examination revealed a soft but tender abdomen, with tenderness localized to the epigastric region and lower quadrants, without guarding, rebound, or other peritoneal signs. The remainder of the physical examination – including HEENT, pulmonary, cardiovascular, extremities, and neurologic systems – was unremarkable.

Laboratory evaluation demonstrated leukocytosis with a white blood cell count of $15.9 \times 10^9/L$ and neutrophil predominance (80.4%). Serum potassium was decreased at 3.1 mEq/L. The anion gap was mildly elevated at 17. Renal and hepatic function tests were within normal limits.

A computed tomography angiography (CTA) of the chest, abdomen, and pelvis with intravenous contrast was performed. The study was non-diagnostic for pulmonary embolism but revealed a small reactive left pleural effusion with associated atelectasis. Importantly, imaging demonstrated gastric staple line dehiscence at the level of the cardia/fundus, associated with a 4.7 cm perigastric abscess and adjacent inflammatory fat stranding [Figure 1].

Figure 1. Axial CT scan demonstrating staple line dehiscence and a contained extraluminal fluid collection.



HOSPITAL COURSE

Upon admission, the patient was made NPO, started on lactated ringers intravenous fluids (125 mL/hr), intravenous antibiotics and antifungals (piperacillin-tazobactam and fluconazole). Discussions were had with interventional radiology to determine whether an image-guided percutaneous drain could be placed within the abscess cavity; however, this was determined to not be possible due to lack of a safe window.

Figure 2. Initial endoscopic evaluation demonstrating the true lumen (green arrow) and the abscess cavity and staple line dehiscence (blue arrow).

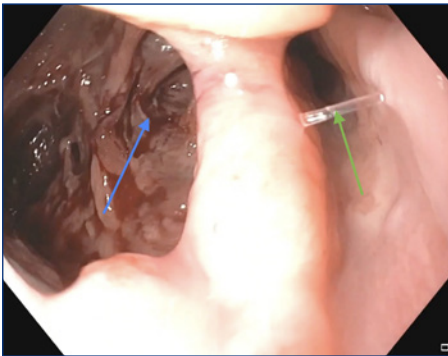


Figure 3. Endoluminal vacuum exchange on hospital day 7 showing formation of granulation tissue in the wound bed.

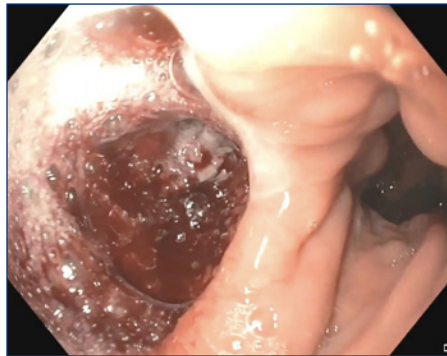
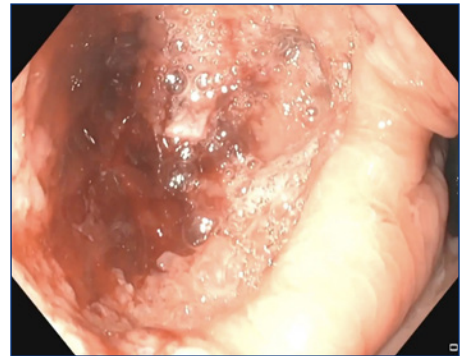


Figure 4. Endoluminal vacuum exchange on hospital day 21 showing significant reduction in size.



An upper gastrointestinal series on hospital day (HD) 2 demonstrated contrast extravasation consistent with a contained staple line leak. Total parenteral nutrition (TPN) was initiated via newly placed peripherally inserted central catheter.

ENDOSCOPIC MANAGEMENT

On HD 2, the patient underwent endoscopic evaluation and washout. There did not appear to be a narrowing at the incisure nor a twist in the sleeve formation. There was a clear staple line disruption at the GE junction, most likely due to a technical failure from stapling too close to the GE junction. Given the lack of technical issues which would require a surgical revision, we elected to place an endoluminal wound vacuum sponge into an approximately 5 cm abscess cavity at the site of staple line dehiscence. The patient was placed on TPN and intravenous fluid support. Serial endoscopic wound vacuum exchanges were performed on HD 7, HD 14, and HD 21, each demonstrating progressive granulation tissue formation and reduction in cavity size [Figures 2–4].

On HD 28, an additional wound vacuum exchange revealed a 1.5 × 0.5 cm granulating cavity and the endoluminal wound vac continued to output high volumes of seropurulent material. On HD 35 he underwent upper endoscopy, at that time it was noted that the cavity had resolved and there was a shallow ulcer in its place. Given the dramatic improvement in the appearance of the staple line dehiscence and the fact that the patient was eager to be discharged after a prolonged hospital stay, an esophagogastric stent under fluoroscopic guidance was inserted. This was done to allow the patient to eat and while minimizing the risk of recurrent abscess collection [Figure 5]. After stent placement, he was able to tolerate clear and full liquid diets, TPN was discontinued, the peripherally inserted central catheter was removed, and intravenous antibiotic therapy was stopped. He was discharged on a bariatric full liquid diet.

Figure 5. Fluoroscopy showing satisfactory stent placement.

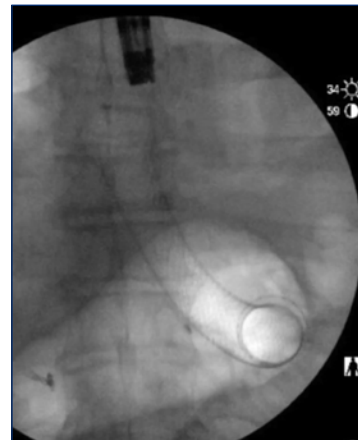


Figure 6. Barium swallow performed after stent removal demonstrating resolution of staple line dehiscence.



Four weeks later, the patient was readmitted for planned stent removal. On stent removal, the previous cavity appeared to have resolved with no further mucosal defect noted. Barium swallow was performed and was without evidence of leak [Figure 6]. He was subsequently discharged on a clear liquid diet and gradually advanced his diet to a solid post-bariatric diet. On follow-up months later, he was doing well with no lasting complications.

DISCUSSION

Staple line leaks after sleeve gastrectomy remain a feared complication with incidences reported between 1% and 3%. Early diagnosis with cross-sectional imaging is critical. Management strategies have evolved from open surgical drainage to minimally invasive techniques. This case illustrates the successful use of endoscopic wound vacuum therapy combined with esophagogastric stenting to manage a challenging

proximal staple line leak. These endoscopic interventions, along with others, have been reported as successful strategies for the management of sleeve gastrectomy leaks.¹

Endoscopic wound vacuum therapy involves placing a sponge connected to a nasogastric tube which is then placed to negative pressure inside the leak cavity. The negative pressure promotes healing through granulation tissue formation and serves as an effective method of source control through removal of wound debris. Endoscopic wound vacuum therapy is highly effective in managing sleeve gastrectomy leaks with success rates ranging between 84–100%.^{1,2} However, one drawback is the need for frequent endoscopic sessions during which time the patient is hospitalized. Most centers perform endoluminal vacuum exchanges every three-five days; however, most patients find the frequent sedation very taxing and for this reason our center has extended exchanges to every five-seven days. Additionally, endoluminal wound vac placement does not address anatomical issues with the sleeve itself, which may lead to persistent leak. Narrowing at the incisura or twisting of the sleeve need to be addressed with serial dilations or even a surgical revision in order for endoluminal therapy to be successful.

Endoscopic stent placement with covered self-expanding metal stents is a commonly used method in the management of foregut leaks, including sleeve gastrectomy leaks. The stent acts as a barrier to exclude the leak site, preventing ongoing leaking/contamination. It is imperative to remember endoscopic stents may need to be combined with an additional drainage procedure to obtain adequate source control. Reported success rates are variable between 65–95% with higher success rates noted in leaks recognized earlier.^{1,3,4} Endoscopic stents allow early enteral nutrition but have been known to migrate.

Endoscopic internal drainage using a double-pigtail plastic stent is an effective method that drains collections internally into the stomach. Similarly to the endoscopic wound vacuum therapy, internal drainage acts as a method of source control, usually abating the need for other procedures. It has a high success rate of 85% when used as the initial modality and 78% when used as a rescue therapy after other methods have failed.⁵ It can be used in delayed presentations/chronic leaks with good efficacy.

Endoscopic clipping with a through-the-scope (TTSC) or over-the-scope (OTSC) method have been described as well. The TTSC are used to close small (<1 cm) defects while the OTSC method can be used on defects up to 3 cm in size. Both TTSC and OTSC have higher success rates when used in early leaks and have an overall successful closure rate of 67%.⁶ The efficacy diminishes in chronic or larger defects and, like stenting, may need additional procedures to achieve adequate source control.

Endoscopic suturing and other adjunctive therapies such as fibrin glue/tissue sealants have been used with variable success. Endoscopic suturing alone had a low success rate of 27% in one retrospective review.⁷ Furthermore, these methods are more effective with acute, small leaks as outcomes

significantly dropped off if suturing was used in delayed leaks (>30 days). The real utility of these adjuncts seems to be in combination with other endoscopic interventions listed previously.

CONCLUSION

This case underscores the role of advanced endoscopic therapies in managing sleeve gastrectomy staple line leaks. Endoscopic wound vacuum systems and esophagogastric stenting can provide effective, minimally invasive alternatives to traditional surgical re-intervention, supporting healing while minimizing morbidity compared to classic surgical revisions.

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Authors

Cody Ness, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

Marcoandrea Giorgi, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

Andrew R. Luhrs, MD, Warren Alpert Medical School of Brown University; Brown University Health, Department of Surgery, Providence, RI.

Disclosures

Cody Ness has nothing to disclose. Marcoandrea Giorgi serves as a consultant for BD and Intuitive. Andrew Luhrs serves as a consultant for BD, Intuitive, and Medtronic.

Correspondence

Andrew R. Luhrs, MD
195 Collyer St, Suite 302, Providence, RI 02904
401-793-5701
Fax 401-793-5171
ALuhrs@brownhealth.org