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Impact of Depression on Weight Loss Post Sleeve Gastrectomy - An Australian Experience

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Abstract

Introduction/aims: Depression is the most common mental disorder found in patients seeking bariatric surgery. Current literature regarding the impact of pre-operative depression on weight outcomes after bariatric surgery is equivocal. Laparoscopic Sleeve Gastrectomy (LSG) is the most commonly performed bariatric procedure in Australia. Few studies have examined the role of depression as a predictor of weight loss post-LSG specifically. Furthermore, this relationship has not been analyzed in an Australian cohort.

Methods: 124 patients underwent LSG. Pre-operative Beck Depression Inventory-II (BDI-II) scores were available for 117 patients. Post-operative weight outcomes were collected at 1 year. Univariate and multivariate analysis was performed to investigate the relationship between pre-operative BDI-II scores and weight loss outcomes at 1 year. A multivariate model was employed to examine the impact of baseline variables including age, sex and pre-operative weight on weight outcomes.

Results: The mean pre-operative weight and BMI was 123.9 kg and 43.1 kg/m^2 respectively. 2 patients were lost to follow-up. The mean post-operative ΔBMI and %EWL at 12 months was 13.1 kg/m^2 and 76.1% respectively. The median pre-operative BDI-II score was 14 (range 1-52), correlating with mild depression. No significant association was found between BDI-II scores and weight outcomes on univariate and multivariate analysis. On multivariate modeling, older age resulted in lower ΔBMI (p=0.001) and TWL (p=0.001). Higher baseline weight was significantly associated with greater ΔBMI, TWL and %TWL (p=0.0).

Conclusion: Pre-operative depression severity was not predictive of weight loss outcomes in this study. Future studies with standardized assessment protocols and follow-up durations are needed to delineate the impact of depression on weight loss after LSG.

Keywords: Depression; Beck Depression Inventory-II; Laparoscopic Sleeve Gastrectomy; Bariatric Surgery; Weight Outcomes.

Special Characters: ΔBMI=Change in BMI.

Introduction

Obesity in Australia is rapidly increasing. National data from the Australian Bureau of Statistics revealed that approximately two-thirds of all Australian adults are overweight or obese. As of 2015, an estimated 4.9 million adults or 1 in 4 Australian adults are obese [1]. Laparoscopic Sleeve Gastrectomy (LSG) is becoming increasingly common worldwide and is the most frequently performed bariatric procedure in Australia (>70% according to the Bariatric Surgery Registry 2017/18 Report) [2]. Depression is the most common mood disorder reported among patients seeking bariatric surgery (BS) [3]. In accordance with the American Society for Metabolic and Bariatric Surgery (ASMBS) Guidelines, a routine psychological evaluation is recommended before bariatric procedures [4]. The point of a thorough pre-surgical psychological and social evaluation is to identify risk factors that can contribute to poor post-operative dietary adherence and surgical outcomes. A recent study has shown a link between mental health disorders and increased length of stay and hospital readmissions [5]. Other studies have found high pre-operative Beck Depression Inventory-II (BDI-II) scores to be linked with reduced physical, psychosocial and sexual Quality of Life post-surgery [6,7].

In regards to the impact of pre-operative depression on weight outcomes post-BS, the results are largely mixed and inconclusive. Variations in definitions of mental illness, methodologies for data collection and follow-up durations contribute to the lack of a clearly interpretable body of evidence in this domain [4]. Furthermore, depression like obesity is a multi factorial disease with biological, psychological and socio-cultural determinants in play. As such there is considerable variability in the presentation and functional impact that depression exerts on various individuals. This leads to difficulty in characterizing the link between pre-surgical depression and post-operative weight outcomes. Given a strong influence of socio-cultural factors in the manifestation of depression, obesity and weight loss; we aimed to explore this relationship in an Australian cohort. To our knowledge, there is no Australian study that examines the relationship between pre-operative depression severity and weight outcomes after LSG; despite it being the most common weight loss surgery performed in Australia. The primary objective of this study is to investigate the impact of pre-operative BDI-II scores on weight outcomes post-LSG in an Australian sample. As a secondary objective we analyzed the impact of demographic variables including age, gender and baseline weight on post-operative weight outcomes.

Methods

Between March 2015 and March 2016, 124 patients underwent LSG by a single surgeon at a specialist multi-disciplinary bariatric centre. Data were collected via electronic medical records and retrospective analysis was performed. Inclusion criteria included minimum of 1 year from date of surgery and availability of 1 year post-operative weights. Of 124 patients, 2 patients did not have 1 year post-operative weights. Multiple attempts were made to contact the 2 patients. Weight outcomes are expressed as change in BMI (ΔBMI), total weight loss (TWL and %TWL), and excess weight loss (%EWL).

Evaluation of psychological fitness for bariatric surgery

Structured interview: In accordance with ASMBS Guidelines [4], the following key areas are explored using both structured interviews as well as screening questionnaires -

- Previous attempts at weight management.
- Maladaptive eating behaviours (binge eating, over eating, grazing) and dietary information.
- Substance abuse.
- Health related risk taking behaviours such as impulsive and compulsive behaviours.
- Coping skills, emotional modulation and current life stressors.
- Psychopathology.
- Developmental history.

Psychopathology: As per the latest ASMBS Statement, current or previous psychiatric history does not preclude a patient from obtaining BS. Instead it has been suggested that the stability of the condition is a more important factor when assessing psychiatric fitness for surgery [4,8]. Detailed psychiatric history with regard to onset, course and treatment (medications, hospitalization, therapy) was sought. A 6-month period of good stabilization, to both symptoms and medication use, was required before surgery. The surgeon and psychologist together assessed the impact BS would have on the patient from the stance of potential exacerbation as well as symptom resolution. No patient required new treatment for depression after the pre-op evaluation and before surgery.

Questionnaires: The pre-surgery screening process included:

- Questionnaire on eating and weight pattern-5 (QEWP-5) to screen for eating disorders.
- BDI-II to screen for depression symptoms.
- Alcohol Screening Questionnaire (AUDIT) to screen for alcohol consumption.
- Drug Screening Questionnaire (DAST) to screen for drug use.

These questionnaires are used to provide additional clinical information that may not have been disclosed by the patient, mistakenly or intentionally, during the clinical interview. Based on the information obtained, patients were categorized as "fit for surgery", "requiring additional counseling prior to surgery" or "being denied surgery".

Beck Depression Inventory-II: BDI-II was used to assess the severity of depression pre-operatively. This is a widely used tool with 21 items exploring depressive symptoms

according to the DSM-IV diagnostic criteria for depression [9]. It has high internal consistency with coefficient alpha of more than 0.90 [10]. It has been validated across different cultures and among the bariatric population [11]. The scoring breakdown is 0-13=minimal depression, 14-19=mild depression, 20-28=moderate depression and 29-63=severe depression.

Statistical analysis

Statistical analysis was performed by a biomedical statistician. This was a cohort study. No a priori sample size calculation was performed. Missing data were not imputed. Differences in pre and post-operative weight outcomes were calculated using paired t-tests. Of the 124 patients, 7 had nil pre-operative BDI-II scores. Subtracting the 2 patients without 12 month post-operative weights, there was a study sample of 115 patients with pre-operative BDI-II scores and post-operative weights. Univariate analysis was performed on this subset to assess associations between pre-operative BDI-II scores and weight loss outcomes. For the purpose of regression analysis, BDI-II scores were calculated as "mild", "moderate" and "severe" against "minimal" scores. BDI-II scores were also collapsed into "mild" and "moderate or severe" categories. Henceforth this is referred to as BDI-II "reduced". Weight outcomes were assessed continuously using linear regression and categorically using logistic regression. The median value in the cohort was used as the cut-point to categorize weight outcomes.

For the subset of patients with post-operative weight outcomes (n=122), a multivariate analysis was performed to study the relationship between age, sex, pre-operative weight and BDI-II scores on weight outcomes. Univariate was first performed using weight outcomes as the dependent variable. Covariates with $p<0.20$ were included in the multivariate model. Linear and logistic regression analysis was again performed. Backwards stepwise regression was performed until all variables had $p<0.05$, unless removal from the model led to >10% changes in the coefficients in the retained model.

Results

Of the 124 patients that underwent LSG, the mean pre-operative BMI was 43.1 kg/m^2 (range 32.5–68.9). Majority (75%) of patients in the study cohort was female and the mean age was 40.9 years. The mean post-operative BMI was 29.8 kg/m^2 (range 20.7–52.1). Patients lost a significant amount of weight post-operatively with a mean ΔBMI of 13.1 kg/m^2 ($p<0.0001$). The pre and post-operative weight characteristics are summarized in table 1. In regards to the subset of 115 patients with BDI-II scores and post-operative weights, the mean age was 41 years. There were 86 females and 29 males. Table 2 summarizes their pre and post-operative weight outcomes.

Table 1 - Summary of pre-operative and post-operative weight outcomes 12 months post Laparoscopic Sleeve Gastrectomy (n =124)

Characteristic	Pre-operative	Post-operative
Mean Weight (SD)	123.9 kg (23.8)	85.7 kg (16.8)
Median Weight	≥ 120.3 kg=62 pts (50%) <120.3 kg=62 pts (50%)	≤ 83 kg=63 pts (51.6%) >83 kg=59 pts (48.4%)
Mean BMI (SD)	43.1 kg/m^2 (6.5)	29.8 kg/m^2 (4.9)
Median BMI	≥ 40 kg/m^2=78 pts (62.9%) <40 kg/m^2=46 pts (37.1%)	≤ 29.1 kg/m^2=62 pts (50.8%) >29.1 kg/m^2=50 pts (49.2%)
Mean ΔBMI (SD)		13.1 kg/m^2 (4.8)
Median ΔBMI		≥ 13.2 kg/m^2=62 pts (50.8%) <13.2 kg/m^2 =50 pts (49.2%)
Mean TWL (SD)		37.8 kg (14.9)
Median TWL		≥ 35 kg=65 pts (53.3%) <35 kg=57 pts (46.7%)
Mean %TWL (SD)		30.1% (9.1)
Median %TWL		≥ 31.7%=61 pts (50%) <31.7%=61 pts (50%)
%EWL (mean, SD)		76.1%, 24.1
Median %EWL		76.7% ≥ 76.7%=61 pts (50%) <76.7=61 pts (50%)

Table 2 - Summary of weight outcomes of 115 patients with pre-operative BDI scores.

Characteristic	Pre-operative	Post-operative
Mean Weight	123.33 kg	85.21 kg
Median Weight	120 kg	82.1 kg
Mean BMI (SD)	42.9 kg/m^2	29.7 kg/m2
Median BMI	41.5 kg/m^2	29 kg/m^2
Mean ΔBMI		13.2 kg/m^2
Median ΔBMI		13.3 kg/m^2
Mean TWL		38.1 kg
Median TWL		35.4 kg
Mean %TWL		30.4%
Median %TWL		31.8%
Mean %EWL		77%
Median %EWL		77.6%

BDI-II scores

Of the 117 patients, majority (48.7%, 57 patients) reported minimal depression, 27 patients (23.1%) reported mild depression and 24 patients (20.5%) reported moderate depression. 9 patients (7.7%) scored severe depression. The median BDI-II score was 14 (range 1-52).

Univariate analysis - Impact of BDI-II scores on weight outcomes

BDI-II and BDI-II reduced scores did not significantly impact any weight loss outcomes, either continuously or categorically. Although, on logistic regression analysis, there was a statistical trend suggesting those with moderate or severe depression were more likely to achieve a ΔBMI that was equal to or greater than the median ΔBMI of 13.3 kg/m^2 found in the cohort (OR 2.29, CI 0.94 to 5.57). This means patients with moderate or severe BDI-II scores were 2.29 times more likely to achieve the median ΔBMI or higher (p=0.067). Similarly, while overall, BDI-II scores had no impact on %TWL, there was a trend that patients who scored moderate depression were more likely to achieve the median %TWL of 31.8% or higher (OR 2.56, CI 0.94 to 6.94) (p=0.065).

Multivariate analysis - Impact of baseline variables and BDI-II scores on weight outcomes

Sex, age, pre-operative weight: Univariate analysis revealed age and pre-operative weight to be significantly associated with all weight outcomes (all p values<0.2), indicating that younger age and greater pre-operative weight resulted in greater weight loss. When accounting for all other variables on multivariate analysis, age and pre-operative weight remained significant.

For each year increase in age there was a

- 0.15 reduction in ΔBMI (p=0.001 CI: –0.25 to –0.62)
- 0.3 kg reduction in TWL (p=0.001 CI: –5.4 to –0.14)

For each kg increase in pre-operative weight there was a

- 0.09 increase in ΔBMI (p=0.00 CI: 0.06 to 0.13)
- 0.4 kg increase in TWL (p=0.00 CI: 0.33 to 0.50)
- 0.14% increase in %TWL (p=0.00 CI: 0.07 to 0.22)

These trends were also significant when performing multivariate logistic regression analysis for TWL and %TWL.

For each year increase in age patients were

- 8% less likely to achieve an above median TWL (p=0.003 CI: 0.88 to 0.98)

For each kg increase in pre-operative weight patients were

- 5% more likely to achieve an above median TWL (p<0.001 CI: 1.03 to 1.08)
- 3% more likely to achieve an above median %TWL (p=0.01 CI: 1.01 to 1.05)

BDI-II scores: On univariate analysis, BDI-II reduced and BDI-II scores were negatively associated with ΔBMI and TWL respectively (p values<0.20). However, on multivariate analysis no significant relationship was sought with weight outcomes.

Discussion

To our knowledge, this is the first Australian study to examine the impact of pre-operative depression severity on weight outcomes post-LSG. In this study we found no significant association between pre-operative BDI-II scores and weight loss outcomes at 1 year post-LSG. To date there is no clear evidence regarding the impact of pre-operative mental health conditions and of depression specifically, on post-BS weight outcomes. Multiple studies have found pre-operative depression to negatively impact weight loss [11-14], while several others have found no association [5,8,9,15-23]. Some studies have also found a positive link with pre-operative depression resulting in greater weight loss [24-26]. While no statistically significant relationship was found in our study, there was a statistical trend suggesting that patients with higher pre-operative BDI-II scores obtained greater weight loss. Müller et al. in their cohort of 99 LSG and 155 RYGB patients showed pre-operative mental illness to result in lower longer-term weight loss. However, when restricting the sample to include only depressive disorders (n=69), patients showed a significantly higher %TWL (p=0.001) at 4 years, compared to patients with no mental illness. A number of explanations can account for such findings. Patients with more severe depression may exhibit different behaviours regarding compliance with post-operative regimens [25]. Obesity and depression, both multifactorial phenomenon, have a bi-directional relationship. Much of the current literature on psychological conditions and obesity is cross-sectional making it difficult to ascertain the direction of causality between psychological disorders and obesity. Is the depression a result of obesity or is it part of the etiology of obesity and hence a cause for it [9]. Depressive disorders have been shown to contribute to obesity via the development of dysfunctional eating and unhealthy lifestyle behaviours. Overeating can be a symptom of depression whereby eating is used as a coping strategy and/or an inexpedient relaxation technique to deal with negative emotions [19,20]. After LSG, patients are required to manage perceived stressors without using food as a coping mechanism. This could explain the higher weight loss in patients with a greater severity of pre-operative depressive scores. On the flip side, weight-based discrimination and stigma associated with obesity may contribute to depression and higher BDI-II scores pre-operatively. Work by Miller-Matero et al. has highlighted the role of increased stress (including symptoms of depression and anxiety) relating to concerns with weight pre-surgery as a positive predictor of weight loss post-surgery [18]. Under this scenario rapid weight loss post-surgery ameliorates depressive symptoms and self-esteem, which improves patients' abilities to adhere to dietary and lifestyle modifications for continued weight loss [6,18,20]. Moreover, evidence suggests a close link between binge eating disorder (BED) and depression [10], both of which have a higher prevalence in bariatric patients [3]. The anatomical restriction posed by LSG would not enable patients to binge and hence stop the vicious cycle between depression, binge eating and weight gain [27].

One of the key difficulties with comparing studies examining pre-operative mental health in BS is that many

combine a heterogeneous group of psychiatric disorders. Compounding this, studies use different diagnostic criteria and modalities to report on psychopathologies. We believed scores from a standardized questionnaire tool would enable the most uniform comparison of depression across patients, time frames and different data sets. Information obtained from psychiatric interview, albeit highly valuable, can create room for error when used for statistical analysis; as such information is influenced by patient-practitioner rapport. We therefore chose to use BDI-II scores for our data analysis, as opposed to information obtained from clinical interviews.

Another issue with current evidence is the heterogeneity in bariatric procedures examined i.e. RYBG/LAGB/LSG/ Gastroplasty and the varying follow-up times. There is evidence suggesting difference in patterns of food tolerances and the hedonic drive among restrictive and malabsorptive procedures, which could independently affect weight loss outcomes [28,29]. To reduce any bias attributable to this, we included one procedure in our cohort. The strong points in our study that reduce bias are: consistency in patient selection, choosing to examine one mental co-morbidity with an objective measure (i.e. BDI-II scores), standardized pre and post-operative management and uniform surgical technique performed by a single surgeon. An inclusion criterion of at least 12 months after surgery was employed as it is shown that weight loss trajectory increases sharply in the first few months after BS, then plateaus or decreases at approximately 12 months [30].

Recent literature has investigated the relationship between pathological eating and post-operative weight outcomes. However, similar to depression, the evidence is equivocal [3]. Pathological eating includes BED, food addiction, loss-of-control overeating and emotional eating. Many of these conditions co-occur with overlapping features [31]. A meta-analysis examining mental health conditions in patients seeking BS showed depression to be the leading mental disorder, closely followed by BED. Prevalence estimates of 19% and 17% respectively were published; both estimates being higher than the background US population [3]. It is noteworthy here to highlight the mediatory role of depression in the development of pathological eating behaviours. Miller-matero et al. showed the main emotional eating behaviours associated with lower %TWL and %EWL post-BS was eating in response to depression and anger/frustration [18]. Schag et al. have discussed the role of depressive symptoms in mediating the relationship between impulsivity and pathological eating behaviours [27]. In bariatric patients, these two conditions have an intertwined relationship, [10,27] further emphasizing the need for their thorough pre-surgical assessment. Besides psychopathology and maladaptive eating behaviours, patient coping skills, emotional modulation, developmental history and patient motivation factors are all significant to assess pre-operatively. We did not include objective measures of eating behaviours and the aforementioned psychosocial factors, although they were assessed in the pre-operative clinical interview. Figura et al. found those with more active coping styles obtained higher %EWL post-operatively [19]. Hilgendorf et al. found social support was a positive predictor of %EWL in their cohort [17]. Ideally including quantitative measures of such factors along with BDI-II, in a multivariate analysis, would render a more holistic analysis of the psychosocial determinants of weight loss post-LSG.

Another limitation of our study is that we did not examine post-operative BDI-II scores as discernibly post-operative mental health would have an impact on weight loss outcomes. We therefore cannot comment on the impact this had on the findings observed in our study. The study was also limited because of its cross-sectional nature and relatively short follow-up durations of 12 months post-surgery. Preferably a longitudinal design investigating the impact of pre-operative mental health on weight outcomes post-LSG at multiple time points greater than 1 year alone, would be beneficial.

In conclusion, this is the first study to evaluate the relationship between pre-operative depression severity and post-operative weight outcomes in an Australian sample of patients undergoing LSG. Our findings indicate that there is no demonstrable weight loss differences associated with severity of pre-operative depression. Younger age and greater pre-operative weight were demographic factors identified in this study, to positively impact weight loss at one year post-LSG. This data suggests that stable and treated depression in individuals with obesity should not preclude them from the benefits of BS. Standardized diagnostic criteria for depression, uniform data collection modalities and sufficient follow-up durations are required to establish adequate evidence–based standardized protocols for the assessment and risk stratification of mental illness in the population seeking BS.

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Statements regarding Conflict of Interest, Ethics and Consent

- The authors declare that they have no conflict of interest.
- All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.
- Informed consent was obtained from all individual participants included in the study.

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