ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 11 | November - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREDICTION OF SUCCESSFUL WEIGHT LOSS FROM PATTERNS OF EARLY POST OPERATIVE WEIGHT LOSS AFTER BARIATRIC SURGERY.

Surgery

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ABSTRACT

BACKGROUND: It has been suggested that early weight loss pattern following bariatric surgery can be used to determine long term weight loss. It should then be possible to identify those patients in early post operative period who will not reach projected optimum weight loss. Such patients can then be specifically monitored and supported to help achieve end goals.

METHODS: 76 patients who underwent Sleeve Gastrectomy or Roux-En-Y Gastric Bypass were enrolled for study. Percentage of Excess Weight Loss (%EWL) was recorded at follow up visits. The association between long term %EWL at 1 year with %EWL at 7 days, 1 month, 3 months of surgery was revealed.

RESULTS: A significant positive correlation was found between %EWL at 1 year vs. %EWL at 1 week (p-value <0.001), 1 month (p-value < 0.001) and 3 months (p-value < 0.001) respectively. Using ROC curves, cut off values of %EWL at 1 week, 1 month and 3 months were found with best combination of sensitivity and specificity to predict patients with insufficient long term weight loss. Finally we innovated a threshold line from cut off values at various follow-up visits as well as 50% threshold value of %EWL at 1 year which can predict patients expected to have poor long term weight loss at any time of follow-up.

CONCLUSION: Patients expected to have insufficient long term weight loss can be predicted in early post-operative period so that such patients can be specifically targeted in the post operative period to achieve the goal of successful weight loss.

KEYWORDS

Obesity; Bariatric surgery; Body mass index; Excess weight loss (EWL).

1. INTRODUCTION

Bariatric surgery is the most successful contemporary intervention for morbid obesity. The anticipated weight loss following bariatric surgery is 12% to 39% of pre-operative body weight or 40 – 71% Excess Weight Loss (EWL) [1-3]. Long term weight loss, as well as improvement in all obesity related comorbidities is sustained following bariatric surgery in the majority of patients [4].

10–20 % patients show insufficient long term weight loss following surgery and as such are deprived of the benefits of bariatric surgery [4,5,6]. Patients who loose ≥ 50% EWL are defined as having successful weight loss, whereas those with < 50% EWL are considered weight loss failures [7]. Knowledge about predictive factors responsible for insufficient post bariatric surgery weight loss is limited. The problem is thought to be multifactorial, including medical, surgical, and psychosocial [6].

Though there are not strong predictors of weight outcomes preoperatively, patients with poor long term weight loss may be identified early in the postoperative period on the basis of early weight change patterns [8–10,14]. Specifically targeting this group of patients by strict post operative follow up with behavioural and intensive lifestyle interventions improves long term weight loss [11-13, 15], highlighting the importance of prediction of these patients in early post operative period.

We studied pattern of early post operative weight loss as a possible predictor of weight loss at 1 year after bariatric surgery. Also an optimal threshold level of weight loss in early post operative period was identified that will help to isolate patients anticipated to have insufficient long term weight loss.

2. METHODS

This retrospective study was done in department of Surgical Gastroenterology, Bariatric and Minimal Access Surgery of BLK Super speciality Hospital where data was retrieved from patients' records between Jan 2016 to Dec 2016. Only those patients who had complete follow up were considered. Patients aged between 18 years to 65 years who underwent Roux-en-Y Gastric Bypass (RYGB) or Sleeve gastrectomy, according to Asian standards as described by Asian Pacific Metabolic & Bariatric Surgery Society were having BMI of > 37 kg/m^2 or > 32 kg/m^2 with diabetes or two significant obesity related co morbidities, were included in the study. All the patients satisfying inclusion criteria in the study period were included in the study using total population sampling methodology.

In RYGB, pouch volume was kept 15 to 30 ml and stoma size was around 2.5 cm with variable length of biliopancreatic and enteric limbs depending on BMI and comorbidities, especially diabetes. In Sleeve gastrectomy, sleeve calibration was done using bougie or endoscope with stapler firing starting 2 – 4 cm from pylorus and ensuring finally that no fundus was left.

2.1. STATISTICAL METHODS

Ideal weight of patients was calculated by Broca's index i.e. Ideal weight (in Kg) = Height (in cm) – 100. Subtracting ideal weight from preoperative total weight, excess weight was calculated. To analyze the association between early post operative weight loss up to 3 months of surgery with weight loss at 1 year, % excess weight loss (%EWL) was recorded at 7 days, 1 month, 3 months and 1 year of surgery. The association between %EWL at 1 year and possible predictors like baseline (pre operative) BMI, % excess weight loss (%EWL) at 7 days, 1 month, 3 months of surgery was done using Mann-Whitney test, Chi-square/Fisher's Exact test and Pearson's Correlation coefficient. ROC curves were used to identify the optimal threshold (cut off) values of %EWL at 1 week, 1 month and 3 months for predicting insufficient weight loss at 1 year and for such values, sensitivity, specificity, positive predictive values, negative predictive values and accuracy were calculated. Also, the confounding effects were accommodated through a multiple linear regression model so as to identify the predictors for the actual %EWL at 1 year on the basis of Baseline characteristics. A p-value < 0.05 was considered statistically significant. The data was stored on MSExcel package while statistical analysis was performed using 'R' programming and/or SPSS version 16.0 software.

3. RESULTS

3.1. Patients' characteristics:

A total of 76 patients with complete records of all follow-ups were

enrolled for our study. Majority of the patients were in the age group 30 - 50 years with a mean age of 42.26±12.36 years and BMI of 44.5±8.03 Kg/m^2. Of these patients, 62 underwent Sleeve gastrectomy and 14 had RYGB.

3.2. Correlation of early %EWL with %EWL at 1 year:

A significant positive correlation was found between %EWL at 1 year vs. %EWL at 1 week (r = 0.676, p-value <0.001), 1 month (r = 0.822, p-value < 0.001) and 3 months (r = 0.835, p-value < 0.001) respectively. The Correlation was strongly positive at 3 months as well as 1 month in comparison to moderately positive at 1 week. This was suggestive that %EWL at 1 week, 1 month and 3 months were predictive of %EWL at 1 year, more specifically %EWL at 3 months and 1 month.

The linear equations for such a relation were found to be

$$\%EWL(1yr) = \begin{cases} 34.97 + 3.156 * \%EWL(1week); R^2 = 0.457 (p-value < 0.001) \\ 28.56 + 2.155 * \%EWL(1month); R^2 = 0.675 (p-value < 0.001) \\ 24.93 + 1.276 * \%EWL(3months); R^2 = 0.696 (p-value < 0.001) \end{cases}$$

The three models showed significantly good explanatory power viz., 45.7% for EWL (1week) predictor, 67.5% for EWL (1 month) predictor and 69.6% for EWL (3 month) predictor. The slope coefficients are interpreted as follows: 1% increase in the %EWL at 1 week will increase the %EWL at 1 year by 3.156%; %EWL at 1 month and 3 months increase the 1 year % EWL by 2.155% and 1.276% respectively.

3.3. Prediction of insufficient weight loss at 1 year from early post operative follow up:

In this study, 15 patients (19.74%) had < 50% of %EWL (weight loss failure) at 1 year while 61 patients (81.26%) had ≥ 50% of %EWL (successful weight loss) at 1 year. These two groups were nominated as group I (%EWL ≥ 50%) and group II (%EWL < 50%). Further, comparisons were made between these two groups with respect to mean %EWL at 1 week, 1 month and 3 months. Mean %EWL at 1 week, 1 month and 3 months were significantly higher in group I patients in comparison to group II patients. This is indicative of higher weight loss at initial follow-ups being good markers for successful weight loss at 1 year.

The threshold (cut off) values of %EWL at 1 week, 1 month and 3 months to predict insufficient weight loss at 1 year were identified. Here, ROC curves were constructed to determine such cut off points with best combination of sensitivity and specificity (Figure 1). The area under the ROC curve for %EWL at 1 week is 77.3% (p-value 0.001), 1 month is 85.8% (p-value <0.001), 3 month is 87.4% (p-value <0.001). This shows that %EWL at 3 months is the best predictor for the successful weight loss at 1 year.

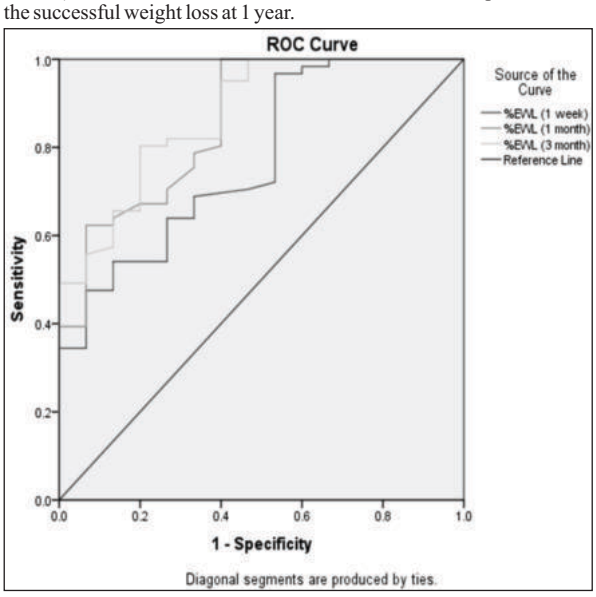

Figure 1: ROC curve of % EWL at 1 week, 1 month, 3 months

Further examination shows that the optimum cut off value of %EWL at 1 week to predict %EWL at 1 year ≥ 50% is 8.85 with a sensitivity of 68.85% and specificity of 66.67%. The PPV and NPV values are 89.36% and 34.48% respectively. Similarly, the optimum cut off value of %EWL at 1 month to predict %EWL at 1 year ≥ 50% is 15.25 with a sensitivity of 70.49%, specificity of 73.33%, PPV of 91.49% and NPV, 37.93% respectively. Also, the optimum cut off value of %EWL at 3 months to predict %EWL at 1 year ≥ 50% is 26.2 and it yields a sensitivity of 80.33% and specificity of 80%. The PPV and NPV values are 94.23% and 50% respectively. (Table 1)

Table 1. Cut off points of %EWL at various follow up visits and of BMI to predict %EWL ≥ 50% at 1 year

Table 2. Cut off points of %EWL at various follow up visits and of BMI to predict %EWL ≥ 50% at 1 year									
		%EWL (1yr) ≥ 50%	%EWL (1yr)< 50%	p-value	Sensitivity	Specificity	PPV	NPV	Accuracy
BMI	≤ 45.15	42 (68.85%)	6 (40%)	0.019$^{\$}$	68.85%	60.00%	87.50%	32.14%	67.11%
	> 45.15	19 (31.15%)	9 (60%)						
% EWL (1 week)	< 8.85	19 (31.15%)	10 (66.67%)	0.006$^{\$}$	68.85%	66.67%	89.36%	34.48%	68.42%
	≥ 8.85	42 (68.85%)	5 (33.33%)						
% EWL (1 month)	< 15.25	18 (29.51%)	11 (73.33%)	<0.001$^{\#}$	70.49%	73.33%	91.49%	37.93%	71.05%
	≥ 15.25	43 (70.49%)	4 (26.67%)						
% EWL (3 month)	< 26.2	12 (19.67%)	12 (80%)	<0.001$^{\#}$	80.33%	80.00%	94.23%	50.00%	80.26%
	≥ 26.2	49 (80.33%)	3 (20%)						

This project finally led to the innovation of line graph (Figure 2) in which a threshold line traversing through cut off values of %EWL at various follow up visits as well as through 50% of %EWL at 1 year is formulated. %EWL under the threshold line (marked in black colour) at any time of follow up will be suggestive of poor long term outcome while the area above the threshold line (grey colour) suggests good long term outcome.

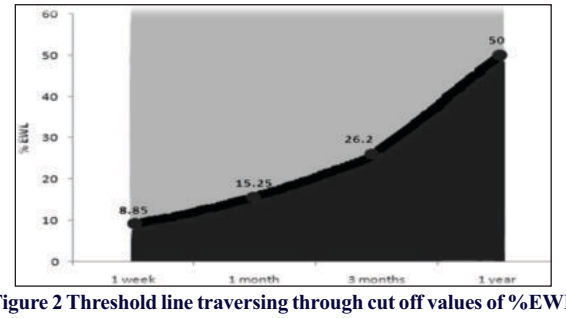

Figure 2 Threshold line traversing through cut off values of %EWL at different follow-up visits as well as 50% of %EWL at 1 year

4. DISCUSSION

The principal objective of this study was to determine the association between early postoperative weight loss and long term weight loss at 1 year. Early weight loss following bariatric surgery as an indicator of long term weight loss has been studied before [10,14]. Mor et al calculated the Weight Loss Velocity (WLV), represented as %EWL/week, in the early postoperative period as the difference between EWL at 3 and 1 months divided by 10 weeks [10].

Using multivariate analysis, the EWL velocity was found to be a statistically significant independent predictor for long term EWL (r=0.51, p=0.0001 for EWL at 12 months; r=0.35, p=0.0001 for EWL at 36 months). Manning S et al using linear regression analyses suggested that %WL at 6 weeks, 3 and 6 months was significantly associated with maximal %WL for patients in both RYGBP and SG groups, more stronger for SG than RYGBP at all three postoperative time points examined [14]. They used WLV during specific postoperative time intervals and suggested that WLV in the 3–6 month postoperative period, compared to 0-6 weeks and 6 weeks to 3 months period, was a stronger predictor of maximal weight loss.

Our data suggests that early post operative %EWL significantly correlates with %EWL at 1 year and hence, early post operative weight loss can predict long term weight loss outcome. Strength of association showed an increasing trend as the time of follow up increased from 1 week to 3 months so that %EWL at 3 months, compared to that at 1 week and 1 month, was more strongly associated with %EWL at 1 year indicating that the accuracy of prediction of patients going to have insufficient weight loss increases as the time of follow up from surgery increases. Instead of time intervals/velocity, we tried to find the association between stat %EWL at each visit and that at 1 year; enabling to predict the poor long term weight loss of a patient even at single post operative visit in case patient had lost earlier follow up visits.

As discussed earlier, long term %EWL < 50% is insufficient weight loss and is considered as weight loss failure [7]. In our study, 19.74% (n=15) had < 50% of %EWL while 81.26% (n=61) had ≥ 50% of %EWL at 1 year. It is estimated that 10–20% of patients show insufficient weight loss after bariatric surgery [4,5,6].

Mor et al established normative categories for percent EWL based on quartiles. Patients who were not in the 1st quartile at 1 month were unlikely to have poor weight loss at 1 year (NPV= 81%, p<0.001). A Receiver Operator Curve (ROC) was constructed to determine the point at which the weight loss velocity predicted 2nd, 3rd, or 4th quartile EWL at 12 months which corresponds to a weight loss velocity of 2% EWL / week (Sn=44%, Sp=90%). Ninety percent of patients with a weight loss velocity greater than 2%/week, remained in the 2nd, 3rd, or 4th quartile for EWL at 12 months. Manning S et al tried to identify patients with suboptimal long term weight loss using early postoperative WLV. They concluded that patients who loose less than 1 lb a week during the 3–6 month postoperative period, approximately 80% (four out of every five) will be having suboptimal long term weight loss.

At all the three follow up visits, we calculated cut off values from ROC curves with their best specificity and sensitivity combination and so the accuracy rate. Patients with %EWL below the cut off value at specific follow up visit is expected to have insufficient long term weight loss and probability of insufficient weight loss depends on the accuracy of cut off value. Velocity of weight loss can't be uniform throughout the post operative period. It does vary as the time period from surgery increases, so the WLV used to predict poor responders by above mentioned studies can't be fixed. Unlike the weight loss velocity used by studies mentioned above, cut off values of each specified visit can independently predict the patients expected to have poor long term weight loss. Cut off values of %EWL were 8.85, 15.25, 26.2 at 1 week, 1 month and 3 months respectively with accuracy rate of 68.42%, 71.05% and 80.26% respectively. Cut off value at 3 months has highest accuracy rate of predicting patients expected to have insufficient weight loss.

Finally we innovated a threshold line from cut off values at various follow-up visits as well as 50% threshold value of %EWL at 1 year which can predict patients expected to have poor long term weight loss at any time of follow-up. %EWL measured by patient himself at home if found below the threshold line can alarm patient to attend the bariatric clinic. So using this graph patients expected to have insufficient weight loss can be specifically targeted in the post operative period to achieve the goal of successful weight loss. This target group needs intensive follow up protocols with behavioural lifestyle interventions, increased physical activity and assessing maladaptive eating behaviours and modifying them. Rudolph A et al [11] in their meta-analysis of five randomized controlled trials suggested greater weight loss in patients with behavioural lifestyle interventions compared with control groups. In a meta-analysis by Egberts K [13], patients who participated in exercise had a standardised mean of 3.62 kg (95% CI□ : 1.28, 5.96) greater weight loss compared to the minimal exercise groups. Keren et al. [15] suggested intensive follow-up protocols could help to lower the failure rate of SG.

One of the limitations of our study was that the follow up of patients was not beyond one year. Since patients with higher BMI may lose more weight beyond 1 year, a prolonged follow up to analyze the real association of pre-opertive BMI with long term weight loss is necessary.

5. CONCLUSION

There is a statistically significant association between early post operative weight loss with weight loss at 1 year and based on this fact cut off values of %EWL can be determined at early post operative visits which will help to identify patients in early post operative period who are expected to have insufficient long term weight loss, so that strict post operative follow up with behavioral interventions, increased physical activity and modification of maladaptive eating behavior is ensured to achieve successful long term weight loss.

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