

FUNDUS TO ANTRUM RATIO MEASURED WITHIN ONE WEEK AFTER ENDOSCOPIC SLEEVE GASTROPLASTY PREDICTS TOTAL BODY WEIGHT LOSS OVER TIME

Kamal Amer MD¹ · Dema Shamon MD² · Donevan Westerveld³ · Louis Aronne³ · Amit Mehta³ · Angela Wong³ · Grace Lo³ · Sarah Oh³ · Andrea Siobhan Kierans³ · Reem Z Sharaiha, MD⁴ · Kaveh Hajifathalian MD¹
 Department of Gastroenterology and Hepatology, Rutgers New Jersey Medical School¹; St. Michael's Medical Center²; Weill Cornell Medicine, New York-Presbyterian Hospital⁴
 Department of Endocrinology Diabetes and Metabolism, Weill Cornell Medicine, New York-Presbyterian Hospital³

Background

- Obesity is a global health concern associated with significant morbidity and mortality among men and women, all racial and ethnic groups, and all ages. Endoscopic sleeve gastroplasty (ESG) is a minimally invasive endoscopic approach to perform a gastric-restrictive bariatric procedure (Figure 1). Measurements post procedure are often visualized via fluoroscopy (Figure 1).
- ESG offers a reversible technique which has a faster procedure time, shorter or no hospital length of stay, and better safety profile when compared to bariatric surgery. Weight loss after ESG appears to be largely mediated through restriction of the stomach volume.
- The aim of this study was to assess fluoroscopic measurement of gastric dimensions after ESG as a predictor of weight loss. Specifically, fluoroscopy was used to measure post procedural change in gastric shape and size (identified as gastric fundus/antrum and fundus/body ratios) to predict Total Body Weight Loss (TBWL) over time.

Methods

Study Population:

- ESG procedure criteria included patients with a body mass index (BMI) of more than 30 kg/m², and failure of previous noninvasive weight loss measures including pharmacotherapy to achieve a sustainable TBWL of at least 5%. Patients who underwent ESG and attended their appointment for fluoroscopy and completed at least 12 months of follow up were included in this study.

Study period:

- Patients who underwent ESG from August 2013 to August 2019
- Patients were included in this study if they attended their appointment for fluoroscopy and completed at least 12 months of follow up.

Exclusion criteria:

- Prior bariatric procedures, family history of gastric cancer, history of neoplastic gastric lesions, major mental health disorders as evaluated by psychologist, coagulopathy, and any significant comorbidities that may interact deep sedation

Statistical analysis:

- Descriptive statistics were reported as means (standard deviation, SD), median (interquartile range, IQR), or counts and proportions.
- Variables were analyzed using paired Student t test, Chi-squared, and Fisher's exact tests in univariable analysis.
- Logistic and linear regressions were used for multivariate analysis.
- Multilevel mixed-effects logistic regression with fixed effect for time since the procedure, and random intercept for individual patients were used to test the linear trend of change in the outcomes after ESG.
- The performance of fluoroscopic parameters was also separately evaluated with receiver operating characteristic (ROC) curve analysis and likelihood ratios

Tables and Figures

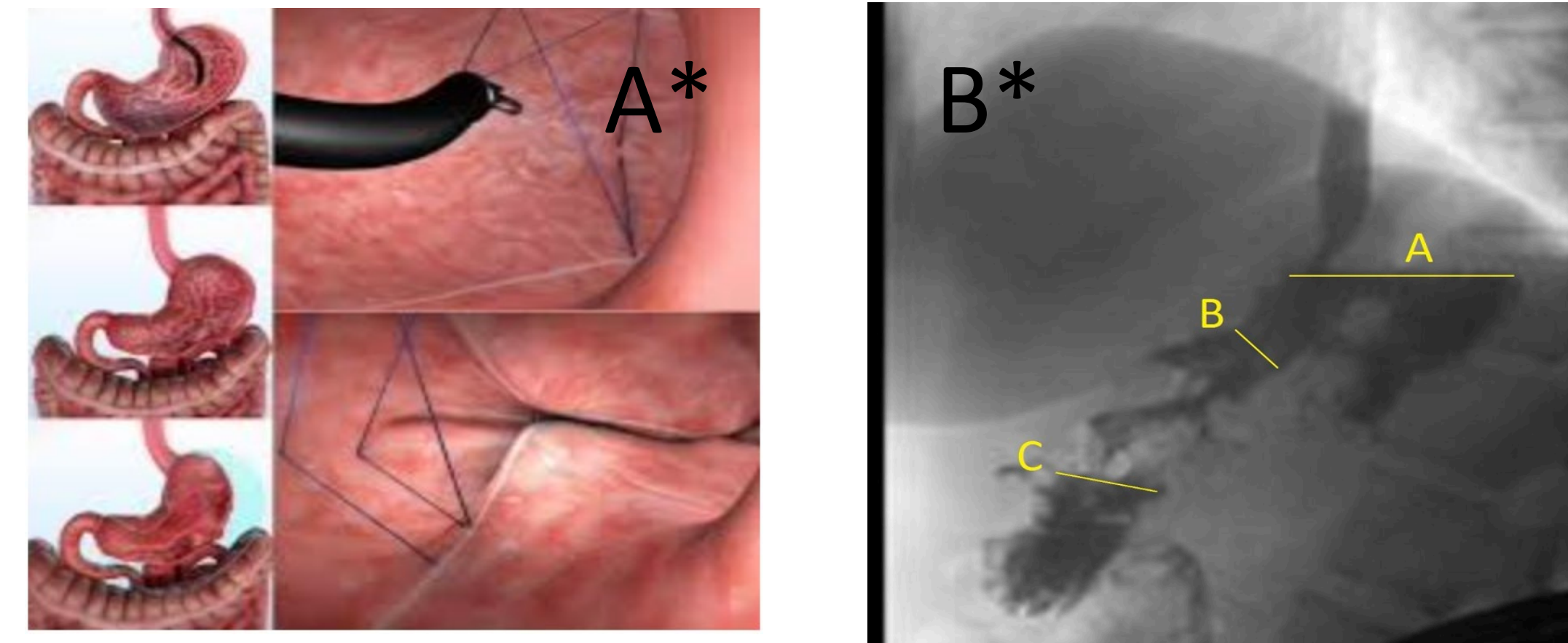


Figure 1. (A*) Endoscopic Sleeve Gastroplasty (ESG) procedure; (B*) Fluoroscopic imaging post-ESG of stomach (A) fundus, (B) gastric body, and (C) antrum

Patient characteristic	Total, N=162	Random building sample, N=81	Random validation sample, N=81
Age, mean(SD), years	46(13)	48(12)	44(13)
Female, n(%)	106(65)	55(68)	51(63)
BMI, kg/m ² , mean(SD)	39(6)	39(6)	38(6)
Fundus to antrum ratio, mean(SD)	1.2(0.6)	1.3(0.7)	1.1(0.6)
Fundus to body ratio, mean(SD)	3.3(1.1)	3.5(1.1)	3.2(1.0)
TBWL%, mean(SD)	16.5(8.3)	15.9(7.8)	17.1(8.8)
TBWL>=5%, (%)	92	90	94
TBWL>=10%,n(%)	75	70	79
TBWL>=15%, (%)	50	48	52

Table 1. Baseline Patient Characteristics of Study Population

Variable	Coefficient	SE	95% CI
Fundus to antrum ratio	0.911	0.326	-0.082 to -0.055
Compliance	2.038	0.410	0.273 to 1.549
Baseline BMI	0.036	0.032	1.234 to 2.843
Time since procedure	-0.069	0.007	-0.027 to 0.099
Intercept	-2.531	1.354	-5.186 to 0.124

Table 3. Parameters of the prediction model for predicting total body weight loss of 10% or more during follow up based on fundus to antrum ratio measured immediately after endoscopic sleeve gastroplasty

Outcomes	Fundus to antrum ratio		Fundus to body ratio	
	OR (95%CI)	p value	OR	p value
TBWL 5% or more	1.93 (0.94-3.97)	0.075	1.02 (0.67-1.55)	0.929
TBWL 10% or more	2.49 (1.31-4.71)	0.005	0.84 (0.58-1.22)	0.361
TBWL 15% or more	2.78 (1.28-6.07)	0.010	0.67 (0.42-1.09)	0.106

Table 2. Association between fundus to body and fundus antrum ratio measured immediately after endoscopic sleeve gastroplasty with total body weight loss during follow up.

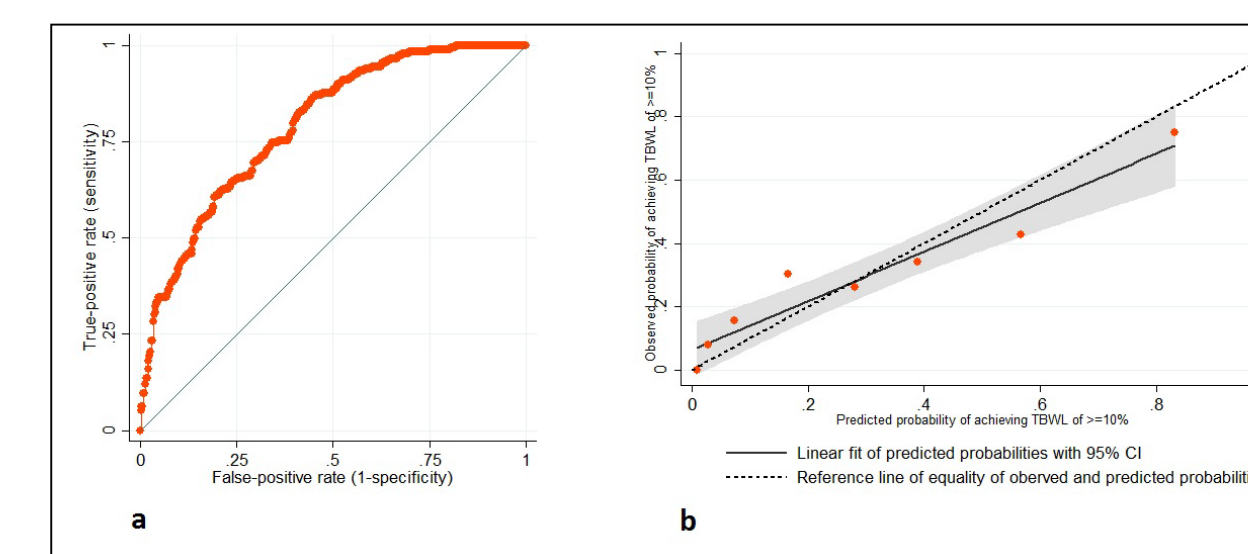


Figure 2. Validation of prediction model based on fundus to antrum ratio measured within 7 days after endoscopic sleeve gastroplasty for prediction of total body weight loss (TBWL) of 10% or more during follow up

Definitions

- Percent Total Body Weight Loss (%TBWL) = $\frac{[(\text{Initial Weight}) - (\text{Postop Weight})]}{[(\text{Initial Weight})]} * 100$
- Percent Excess Body weight loss (%EWL) = $\frac{[(\text{Initial Weight}) - (\text{Postop Weight})]}{[(\text{Initial Weight} - \text{ideal body weight})]} * 100$
- Ideal body ideal weight is defined by the weight corresponding to a BMI of 25 kg/m²

Results

General Characteristic Results

- 162 patients were included in the analysis. 65% of the patients were female, and patients had a mean BMI of 39±6 at baseline.
- Overall, patients had a mean maximum TBWL of 16.5±8.3%. 92, 75, and 50% of patients achieved a TBWL of 5%, 10%, or 15% or more, respectively (Table 1).
- On fluoroscopic examination none of the patients had contrast extravasation after ESG.
- The mean post-procedural UGI gastric fundus/antrum transverse measurement ratio was 1.2±0.6, and fundus/body ratio was 3.3±1.1 (Figure 1, B*).

Prediction Model:

- A random sample of 81 patients were included in the building sample to generate models for predicting %TBWL during follow up based on F/A ratio 7 days post procedure.
- The fundus to body (F/B) ratio was not associated with weight loss during follow up after adjusting for patients' compliance and baseline BMI (Table 2).
- Higher fundus to antrum (F/A) ratio was significantly associated with the primary outcome of TBWL of 10% or more during follow up in multivariable model (OR 2.49, 95% CI 1.31-4.71; p value 0.005).
- Higher fundus to antrum ratio was also significantly associated with TBWL of 15% or more and showed a trend towards an association with weight loss of 5% or more during follow up (Table 1).

Validation:

- Prediction score from the multivariable model had an area under the ROC curve of 0.79 (95% CI 0.75-0.83) for predicting a TBWL of 10% or more during follow up (Figure 2-a).
- The calibration plot showed appropriate calibration for the agreement between observed and predicted probabilities of achieving 10% TBWL or more across 8 deciles of predicted probability in the validation sample (Figure 2-b).
- Fundus to body ratio of equal to or more than 1.23 as a univariable predictor had a sensitivity of 60.6%, and specificity of 61.0% for achieving a TBWL of 10% or more during follow up, and classified 60.9% of outcomes correctly, with a positive likelihood ratio of 1.6 and a negative likelihood ratio of 0.7.

Conclusion

- Non-invasive endoscopic techniques, such as ESGs have become increasingly common over the past decade leading to alternative management options for patients seeking sustained weight loss.
- ESG is effective for achieving significant weight loss with a mean TBWL of 17% observed in this study.
- Gastric fundus/antrum ratio measured within one week of ESG appears to be a consistent and independent predictive measure of sustained TBWL during long-term follow up after the procedure
- Focusing on the body of the stomach for suturing to create a larger fundus to antrum ratio can potentially lead to better weight loss outcomes and fewer complications.