Predictive Model for Refractory Benign Esophageal Strictures

Matthew G. Bell, MD[1], Ross A. Dierkhising, M.S.[2], and Karthik Ravi, MD[3]

[1]Department of Internal Medicine, Mayo Clinic, Rochester, Minnesota; [2]Division of Clinical Trials and Biostatistics, Mayo Clinic, Rochester, Minnesota; [3]Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota

INTRODUCTION

BACKGROUND

Refractory benign esophageal strictures (RBES) are defined by inadequate response to endoscopic dilation. While adjunctive modalities such as corticosteroid injection improve outcomes in RBES, the lack of reliable predictors of refractory risk results in therapeutic delays with associated cost and morbidity.

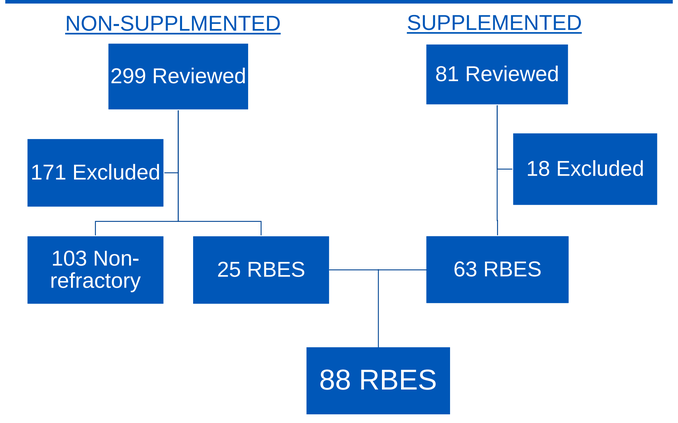
AIM

We sought to establish a predictive model for RBES.

METHODS

Patients were identified through search of CPT codes for esophagogastroduodenoscopy (EGD) with esophageal stricture dilation, with identified cases performed after October 1, 2012 reviewed sequentially (non-supplemented). In addition, a cohort of RBES patients from a prospectively maintained clinical database of self-dilation patients was identified (supplemented). Demographic information, endoscopic findings, and dilation characteristics were collected. Malignant strictures, Schatzki rings, and previously treated strictures were excluded. RBES was defined by inability to achieve or maintain a diameter ≥14mm over 5 consecutive dilation sessions. Univariate and multivariable regression models were performed. Multivariable models were chosen by minimizing the AIC statistic, with model intercepts accounting for the true prevalence of RBES in the non-supplemented cohort.

WORKFLOW



RESULTS

Table 1: Risk Factors for Non-Refractory vs. Refractory Benign Esophageal Strictures

	Non-Refractory (n=103)	RBES (n=88)
Gender		
Male	48 (46.6%)	59 (67.0%)
Female	55 (53.4%)	29 (33.0%)
Age		
Median (Q1, Q3)	60.6 (50.8, 71.4)	67.1 (58.6, 72.4)
Etiology		
Radiation	13 (12.6%)	45 (51.1%)
Anastomotic	17 (16.5%)	24 (27.3%)
EOE/LP	17 (16.5%)	9 (10.2%)
Peptic	47 (45.6%)	6 (6.8%)
CP Bar/Web	8 (7.8%)	0 (0.0%)
Caustic Ingestion	1 (1.0%)	4 (4.5%)
Stricture Length (cm)		
Median (Q1, Q3)	1.0 (1.0, 2.0)	2.0 (1.0, 3.0)
Stricture Diameter (mm)		
Median (Q1, Q3)	12.0 (8.2, 15.0)	6.0 (4.0, 8.0)
Stricture Location		
Diffuse	4 (4.2%)	3 (3.4%)
Lower	54 (56.8%)	10 (11.4%)
Middle	6 (6.3%)	11 (12.5%)
Upper	31 (32.6%)	64 (72.7%)

128 patients with index EGD and esophageal dilation were identified, with 25 (19.5%) meeting criteria for RBES. An additional 63 RBES patients were identified from the self-dilation patient cohort for a total of 88 RBES and 103 non RBES patients included in the analysis. Break down of demographics, stricture description, and endoscopic characteristics are featured in **Table 1.** Male gender, longer length, smaller diameter, upper/middle esophageal location, and radiation induced strictures were associated with RBES ($p< 0.05$) **(Table 2).** Given inconsistent reporting of stricture length and diameter, multivariable analysis both with and without these variables was performed with both yielding strong predictive models with c-statistic of 0.87 and 0.85, respectively (**Table 2**).
EOE= Eosinophilic Esophagitis, LP= Lichen Planus, CP= Cricopharyngeal

Table 2: Multivariable models for RBES with and without consideration of stricture length and diameter

Variable	Odds Ratio	CI	p-value	Model Coefficient	Model Intercept
Model 1: n=116, c=0.87					-0.3963
Stricture Length	1.34	0.95-2.17	0.174	0.2927	
Stricture Diameter	0.73	0.61-0.72	<0.001	-0.3131	
Lower Esophagus Location	0.23	0.07-0.72	0.012	-1.4765	
Model 2: n=183, c=0.85					-3.581
Anastomotic	0.3	0.11-0.76	0.012	-1.2024	
EOE/LP	0.45	0.14-1.47	0.185	-0.7912	
Peptic/CP Bar	0.07	0.02-0.24	<0.001	-2.6409	
Male Gender	3.15	1.45-7.10	0.004	1.147	
Lower Esophagus Location	0.24	0.08-0.70	0.009	-1.4354	
Age	1.03	1.00-1.06	0.035	0.0304	

Using the coefficients and intercepts from **Table 2,** a predicted probability formula can be used ot calculate RBES risk prediction. Where Score=Intercept +coefficient1 *variable1 + coefficient2 *variable2 +…. and Risk= 1/1+exp(-Score)). Please see **Application** section an example of formula utilization.

APPLICATION

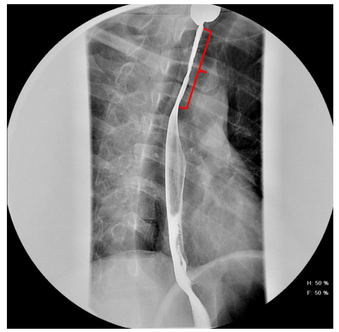


Figure 1: Esophagram from a 35-year-old-male who sustained caustic ingestion injury leading to this 7cm stricture in the proximal esophagus (red bracket). Endoscopy displayed a minimum stricture diameter of 4mm. Utilizing model 1, which includes stricture length and diameter, this patient had a predicted RBES risk of 0.60 at the time of index endoscopy.

Are you interested in testing the risk calculator for yourself? Please use this URL below to see a sample interactive calculator. Both **model 1** and **model 2** are available through this link. Please note that neither model has been clinically tested or validated.

https://form.jotform.com/222086641227150

DISCUSSION

RBES is associated with significant morbidity and procedural burden. A predicative model for RBES would be valuable as it would allow for earlier adoption of more aggressive treatment alternatives. We were able to develop a model for RBES prediction. While the number RBES cases was relatively low, it still represents the largest described clinical experience to date. In addition, the utilization of a supplemented cohort (self-dilation) may have introduced cofounding factors based on the demographic of patients who choose to pursue self-dilation, however no differences in the supplemented and non-supplemented cohorts were identified . Future work could focus on either expanding the sample of size of the analysis or moving forward with validation of the current model.

CONCLUSION

RBES can be predicted at index EGD based on patient characteristics and stricture features. Further, we demonstrate that a strongly predictive formula can calculate RBES risk on a case-by-case basis, potentially allowing for individualized patient care to guide therapeutic approach and reduce associated morbidity and cost in esophageal stricture management.