

MARSHMALLOW-BAGEL UPPER GASTROINTESTINAL STUDY IN
PARAESOPHAGEAL HERNIA PATIENTS

by

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Abstract

The traditional method used to evaluate esophagus and foregut functions prior to surgical treatment is esophageal manometry. Esophageal manometry is the insertion of a pressure sensitive catheter through the nose into the esophagus. During an esophageal manometry, the patient is asked to perform swallowing maneuvers. The esophageal manometry provides information on the status of esophageal muscle function, coordination, and contraction. The results establish which anti-reflux technique the esophageal musculature can tolerate. Many patients show difficulty swallowing with the esophageal manometry technique. An alternative method for monitoring esophageal muscle movement is to have the patient swallow a barium-soaked marshmallow followed by a barium-soaked bagel portion. When the patient swallows the items, the surgeon tracks the movement through the gastroesophageal junction. The ability to swallow the portions indicates to the surgical team that the patient can tolerate the anti-reflux surgery. The surgical outcomes following patients who undergo the marshmallow-bagel study in comparison to those who complete the full esophageal manometry were analyzed for significant differences. The null hypothesis is that patients receiving the esophageal manometry and patients receiving the marshmallow and bagel show no difference in outcome regarding the ability to swallow, toleration a regular diet, presence of dysphagia, presence of odynophagia, need for postoperative steroids, and need for esophageal dilation. Two patient groups were divided by the charts of patients who underwent preoperative procedures for a paraesophageal hernia repair. The first population included patients who only received the marshmallow-bagel technique before surgical treatment. The second population included patients who only received an esophageal manometry before surgical intervention.

Keywords: marshmallow-bagel study, paraesophageal, hernia

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Marshmallow-Bagel Upper Gastrointestinal Study in Paraesophageal Hernia Patients

Patients scheduled to undergo surgical procedures for paraesophageal hernias, hiatal hernias, and gastroesophageal reflux disease have first to be assessed through a preoperative evaluation. The current traditional method a physician uses to evaluate how a patient's esophagus and foregut functions before surgical treatment, is an esophageal manometry involving the insertion of a pressure sensitive catheter through the nose down through the esophagus. Frequently, it was observed that many patients have great difficulty swallowing with the esophageal manometry technique. It was also found that the catheter can get lodged preventing it from passing through the hernia (Lal, 2017). An alternative method of introducing barium for monitoring the esophagus is to have the patient swallow a barium-soaked marshmallow followed by barium-soaked bagel portion. If the patient is able to swallow these items, the surgeon can track via x-ray the movement through the gastroesophageal junction. The ability to swallow both items is crucial because it indicates to the surgical team that the patient can tolerate the strongest type of anti-reflux surgery. The surgical outcomes following patients who undergo the marshmallow-bagel study in comparison to those who complete the full esophageal manometry were to be measured to confirm any significant differences.

Background

Conditions such as hiatal hernias along with gastroesophageal reflux disease often require surgical intervention. There is an opening in the muscular wall that separates the abdomen from the chest cavity called the hiatus. A hiatal hernia is when the stomach pushes into this opening in one of two ways. The paraesophageal hernia is when the stomach pushes into the hiatus opening beside the esophagus. The sliding hernia is when the stomach and a section of the esophagus

slide up through the hiatus. Gastroesophageal reflux disease (GERD) is when the frequency of stomach acid flowing back into the esophagus causing damage (Hyun & Bak, 2011). All of the above conditions are a valid reason for considering a surgical repair option. Anti-reflux surgical procedures include a laparoscopic hiatal hernia repair and often a Nissen fundoplication. The Nissen fundoplication involves the upper part of the stomach being wrapped around the lower esophageal sphincter to strengthen it and prevent acid reflux (Seeras & Siccardi, 2019). To repair the hiatus, a few laparoscopic stitches are created to reduce the opening in the diaphragm to a smaller hole. When performed laparoscopically the doctor makes a few small incisions to insert both the camera and instruments into the abdomen, allowing for the procedure to be viewed on a monitor above the patient. Before a patient is allowed to undergo the surgical procedure, they must complete an evaluation of their esophagus (Hyun & Bak, 2011). The most widely-used evaluation is esophageal manometry. During the traditional esophageal manometry, patients are asked to do several swallowing exercises while their esophageal muscle function is tracked on a high-resolution plot. Interpretation of this plot and the variables determined in the manometry study gives valuable information about the function, contraction, and coordination of the esophageal muscles. This information helps determine the best type of anti-reflux technique to incorporate as part of the surgical procedure, based on the ability of the esophageal musculature to tolerate the resistance placed on the esophagus by the anti-reflux procedure. The esophageal manometry method has been utilized since the late 1950s. During this time patients have frequently had difficulty swallowing while the pressure sensitive catheter is in their throat. This issue prevents the medical team from being able to correctly evaluate the functioning ability of the patient's esophagus (Lal, 2017). Utilizing a barium-soaked marshmallow and bagel is a non-invasive and cost-effective method to guide medical decisions.

The Purpose of the Study

The purpose of this study is to record and analyze the outcomes among patients who underwent surgery after a marshmallow-bagel swallow study and compare it with the outcomes of those who underwent a full esophageal manometry. Patients often struggle during esophageal manometry as it is difficult for them to swallow with the catheter down their esophagus. The catheter itself can often get stuck in hiatal hernias that are present. A less invasive alternative to the esophageal manometry could be the marshmallow-bagel technique. However, the marshmallow-bagel techniques would need to be just as useful in assessing the ability of the patient's esophagus to withstand operations such as the Nissen fundoplication. There will be no difference in surgical outcomes including complications, resolved symptoms, presence of dysphagia, hospital readmission, postoperative LINX band-removal, postoperative esophagogastroduodenoscopy, and postoperative proton pump inhibitor use.

Methods

Two populations are evident in this study. The first population of seventy-two patients received the preoperative evaluation of the marshmallow-bagel technique before surgical treatment of a hiatal hernia or gastroesophageal reflux disease. The second population of nine patients received an esophageal manometry before the surgical intervention of a hiatal hernia or gastroesophageal reflux disease. The following surgical outcomes were compared across both populations: the presence of dysphagia, surgical complications, resolved symptoms, hospital readmission, postoperative LINX band removal, postoperative esophagogastroduodenoscopy, and postoperative proton pump inhibitor use. Demographics and surgical conditions were compared through quantitative, and qualitative analysis to verify there were no significant variations between the two populations. Demographics measured in both populations included:

gender, age, and body mass index score (BMI). Surgical conditions analyzed included: previous operations for anti-reflux, previous proton pump inhibitor use, previous gastropexy surgery, size of LINX inserted, operation time, the blood loss during the operation, and hernia size.

Institutional Review Board approval was obtained for research with human subjects before patient medical charts were accessed. All data for this study was provided through the patient's relevant medical records in the hospitals encrypted redhat database. Access to this data was granted by Dr. James E. Speicher of the Cardiothoracic Department at the Brody School of Medicine. Following all CITI ethics training with human subjects, data were analyzed using quantitative and qualitative observations from patients in both populations. Qualitative data were analyzed using Fisher's exact test to calculate a p-value of statistical significance in the two patient groups. Quantitative data were analyzed using a T-test to calculate a p-value of statistical significance in the two patient groups. Quantitative variables measured were age, BMI, operation duration in minutes, size of LINX, and blood loss in milliliters. Qualitative variables measured were gender, previous proton pump inhibitor use, previous anti-reflux surgery, previous gastropexy surgery, hernia size, complications, resolved symptoms, presence of dysphagia, postoperative LINX band removal, postoperative esophagogastroduodenoscopy, hospital readmission, and postoperative proton pump inhibitor use.

Results

All variables within demographics, surgical conditions, and surgical outcomes were compared using a p-value of statistical significance. Demographic p-values are presented in table 1. Surgical conditions are presented in table 2. Surgical Outcomes are presented in table 3. The process of calculating the p-value varied based on the nature of the variable and is included in the methods above. A p-value ≤ 0.05 represents strong evidence for rejecting the null hypothesis.

In table 1 the p-value of Body mass index score was 0.0385, and the only variable to have a p-value ≤ 0.05 . However, in this instance, the statistical significance shown can be attributed to the body mass index score requirement for patients to be admitted to surgical treatment.

<i>Table 1</i>	
<i>Demographics</i>	
<u>Variable</u>	<u>p-value</u>
Age	0.17
Gender	0.71
Body Mass Index Score	0.04

<i>Table 2</i>	
<i>Surgical Conditions</i>	
<u>Variable</u>	<u>p-value</u>
Previous Anti-Reflux Surgery	1.00
Preoperative Proton Pump Inhibitor Use	0.58
Previous Gastropexy Surgery	0.48
Size of LINX Inserted	0.90
Duration of Operation	0.05
Blood Lost During Operation	0.41
Size of Hernia	0.12

<i>Table 3</i>	
<i>Surgical Outcomes</i>	
<u>Variable</u>	<u>p-value</u>
Complications	0.21
Resolved Symptoms	0.21
Dysphagia	0.72
Postoperative LINX Band Removal	1.00
Postoperative Esophagogastroduodenoscopy	1.00
Hospital Readmission	0.21
Postoperative Proton Pump Inhibitor Use	0.34

Conclusions

All surgical outcomes in table 3 above showed no statistical significance with p-values substantially above 0.05. The null hypothesis in this study has failed to be rejected, and therefore

supports the marshmallow-bagel upper gastrointestinal study as a valid alternative for preoperative evaluation of paraesophageal hernia patients. The next step in advancing research into the marshmallow-bagel upper gastrointestinal study is to increase the number of participating patients and perform a regression analysis with the new larger population.

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