

## Adjustable Gastric Banding for Morbid Obesity: Radiographic Assessment, Preoperative Findings and Complications

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**Abstract: Purpose:** The purpose of this study was to determine the role of radiology in assessing patients, who had undergone adjustable gastric banding (AGB) procedures for the treatment of morbid obesity, and to find out the type and prevalence of pre-operative findings as well as to evaluate the frequency and type of postoperative complications. **Material and Methods:** Sixty-one patients (29 men, 34 women; mean age, 36.5 years; age range, 20-53 years) with morbid obesity (ranged from 35.7 to 66.1 kg/m<sup>2</sup>; mean body mass index, 50.9 kg/m<sup>2</sup>) underwent AGB surgeries. In all patients, radiographic Gastrografin Swallow examinations were performed preoperatively to eliminate any AGB surgery contraindications such as ulcerations, hiatus hernias, narrowing, obstruction and achalasia, and one day post-surgery to eliminate leakages and stenosis. All patients underwent another examination at one month, two months and three months postoperatively and whenever a complication is suspected or if there is insufficient weight loss (i.e. less than 5 kg/month) for adjustment of the gastric band diameter. **Results:** 60 patients underwent the procedure via laparoscope, and 1 patient via open surgery. The most common preoperative findings were gastroesophageal reflux (84.1%) and mucosal hypertrophy (25%). No perforations were found at one-day post-operations. Late postoperative complications occurred in 9.8% of patients and included stenosis, infection, port malposition and bolus impaction. **Conclusion:** Radiographic assessments play a key role in the pre-operative screening of AGB patients. It also plays a significant role in the detection of postoperative complications and managements of weight loss.

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### 1. Introduction

Morbid obesity is a serious, chronic disease usually defined as having a Body Mass Index (BMI) of 40 kg/m<sup>2</sup> or more<sup>1</sup>. Although it is commonly thought that overeating is what leads to obesity, it is not the only cause. Other contributing factors may be genetic, environmental, metabolic, eating disorders and certain medical conditions such as hypothyroidism<sup>2</sup>. Morbid obesity is associated with many secondary diseases that can greatly reduce the quality of life; such as diabetes II, hypertension, high cholesterol, respiratory problems, depression and osteoarthritis of weight-bearing joints<sup>3</sup>. The simplest treatment for obesity is a healthy diet and exercise. However, morbid obesity is a complex disease and this method often fails in the long-run. For this reason, the use of weight loss surgery as a treatment for morbid obesity is growing considerably.

Weight loss surgeries induce weight loss in patients by either decreasing food intake in a restrictive procedure, or by altering digestion in a malabsorptive procedure. Sometimes, procedures done are a combination of both restrictive and malabsorptive<sup>4</sup>. All of these surgeries have both advantages and risks. One of the weight loss

surgeries which has become increasingly popular is the purely restrictive Adjustable Gastric Banding surgery.

Gastric banding surgery induces weight loss by reducing the amount of food intake. The surgery entails fastening an inflatable silicone band around the upper part of the stomach to divide it into two pouches; a small, proximal one and a large, distal one<sup>5</sup>. The silicone band is attached to a tube that ends with a subcutaneous port attached either under the external thoracic fascia, or to the rectus abdominis muscle. Through this port, fluid can either be injected or aspirated to control the size of the gastric band. As a result, the passage of bolus will either slow down or speed up thus allowing the amount of food intake to be controlled<sup>6</sup>.

The majority of the gastric banding surgeries are guided by laparoscope. However, all of the post-operative follow-up of the patient is done in the radiology department through Barium Swallow examinations. The patient must also undergo an abdominal ultrasound exam and a Barium Swallow exam pre-operatively to be able to qualify for the surgery. To be able to manage weight loss and effectively detect postoperative complications,

radiographic assessment is necessary<sup>7</sup>. This study describes the radiological examination technique used both pre-operatively and post-operatively, assess the role of radiographic evaluation and determine the variety of potential post-operative complications.

## 2. Material and Methods

The image findings of sixty-one obese patients (29 men, 34 women) who had undergone adjustable gastric banding (AGB) surgeries (age range 20-53, mean age 36.5) were reviewed thoroughly. Of these patients, only one had open surgery due to an enlarged liver. The remaining patients underwent the procedure laparoscopically.

The patients' Body Mass Indexes (BMI's) ranged from 35.7 to 66.1 with a mean of 50.9. Each BMI was calculated after carefully measuring the patients' weight in kilograms and height in meters and using the following equation:

$$\text{BMI} = \frac{\text{Weight in kg}}{(\text{Height in m})^2}$$

A preoperative Gastrografin study of the upper gastrointestinal tract was initially performed on all the patients to eliminate any AGB surgery contraindications such as ulcerations, hiatus hernias, narrowing, obstruction and achalasia. The erect patients were instructed to drink about 50 ml of Telebrix Gastro contrast medium while a radiologist assessing the related anatomy fluoroscopically. Images of the lower esophagus and the stomach were obtained both erect and supine, and at times prone.

One day post-surgery, another Gastrografin study is performed to eliminate leakages and stenosis. The follow-up protocol included Gastrografin studies to be performed one month, two months and three months after surgery and whenever a complication is suspected or if there is insufficient weight loss (i.e. less than 5 kg/month). At each follow-up study, patients' weight and food intake are taken into consideration.

The decision to modify the diameter of the gastric band is based on two things; the rate of the patient's weight loss and the fluoroscopic evaluation of the Gastrografin Swallow examination. The acceptable weight loss range is between 5 kg and 12 kg per month. Therefore, the diameter is decreased when there is insufficient weight loss. During fluoroscopy, the gastric band diameter is modified when the passage of the Gastrografin from the esophagus into the stomach is not approximately 40 seconds, and is accordingly either tightened or loosened.

## 3. Results

Sixty-one patients underwent the gastric banding surgery; sixty of them via laparoscope and one via open surgery.

[Figure 1] shows the three parts of the adjustable gastric band device as well as the passage of food after a gastric banding procedure. The band can clearly be seen around the upper end of the stomach. This is connected to a silicone catheter which ends in a subcutaneous port. It shows food passing through the esophagus and reaching the upper gastric pouch where space is limited due to the band.

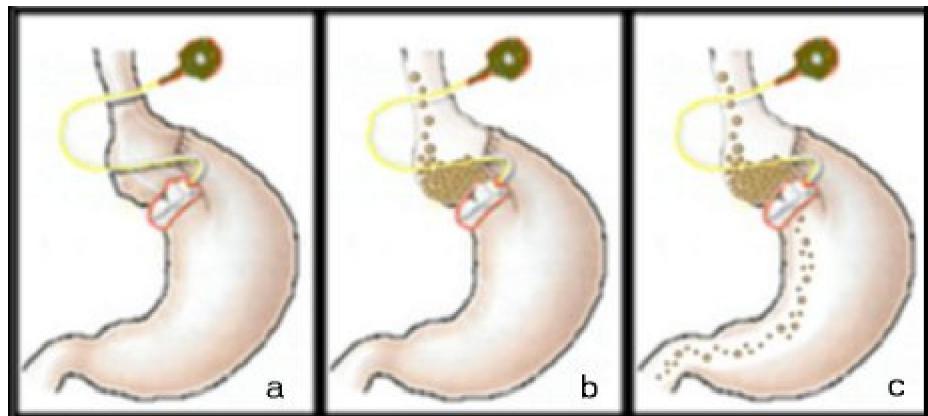
[Figure 2,3] show a Gastrografin swallow examination prior to the gastric banding surgery. In [Figure 2], the Gastrografin is clearly seen descending and lining the esophagus of the patient after swallowing it and reaching the gastroesophageal junction. In [Figure 3], the Gastrografin has spilled into the stomach thus visualizing it.

[Figure 4, 5] show a post-operative Gastrografin swallow examination and a fluoroscopic band tightening procedure. In [Figure 4], the parts of the gastric banding device can clearly be seen in the abdomen. It shows the band around the upper part of the stomach and the connecting silicone catheter leading to the subcutaneous port. In [Figure 5], the parts of the gastric banding device can again be seen in the abdomen. In addition, a needle can be seen positioned in the port. Gastrografin has visualized the whole device as it is injected into the port, runs through the silicone catheter into the band and tightening it.

[Figure 6] shows the findings of the patients' pre-operative Gastrografin Swallow examinations. Four patients were found to have hiatus hernias (9.1%), four patients were reported to have ulcerations (9.1%), thirty-seven patients were noted to have gastroesophageal reflux (84.1%), no patients were found to have esophagitis, two patients were found to have gastritis (4.5%), three were found to have duodenitis (6.8%) and one patient had a diverticulum (2.3%). Nine patients were reported to have cascade stomachs (20.5%), nine were reported to have slight deformities of the duodenal cap (20.5%), eleven were reported to have hypertrophy of the mucosa (25%) and two were reported to have thickening of the mucosal wall (4.5%).

During the post-operative Gastrografin Swallow examination one day after the surgery, no patients were found to have perforations.

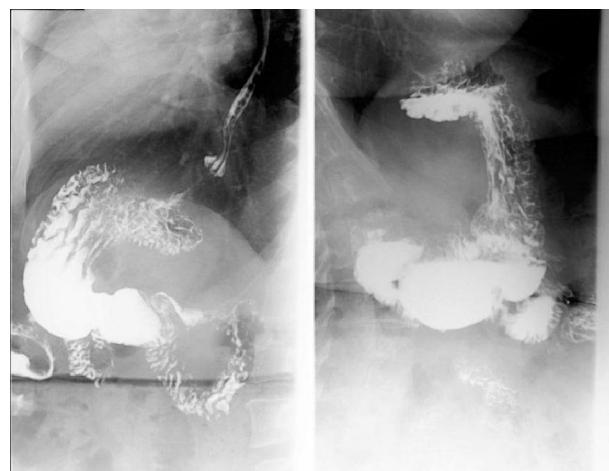
[Table 1] shows that six patients developed complications. Three patients developed stenosis. One of these three patients additionally developed esophageal distension. One patient developed an infection, one patient had an impaction of bolus at the gastroesophageal junction, and one patient developed a malposition of the port.



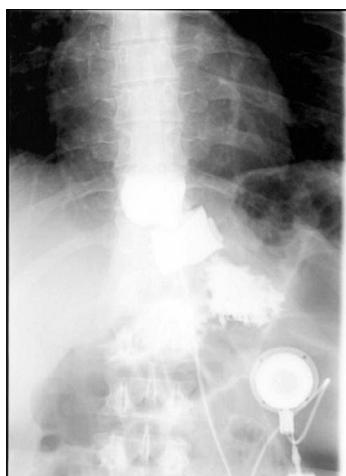
**Figure 1:** Food passage after Gastric Banding image taken from Ethicon Endo-Surgery's *Diet Instructions for patients after Gastric Banding*, page 3a. The stomach after "banding" procedure; b. Food passing the esophagus and filling the upper gastric pouch; c. Food passing the narrow channel



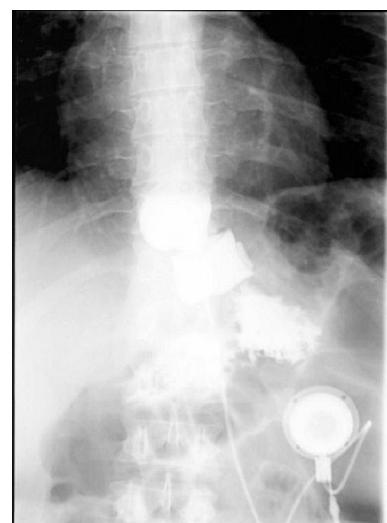
**Figure 2:** Pre-operative Gastrografin Swallow:  
Esophagus



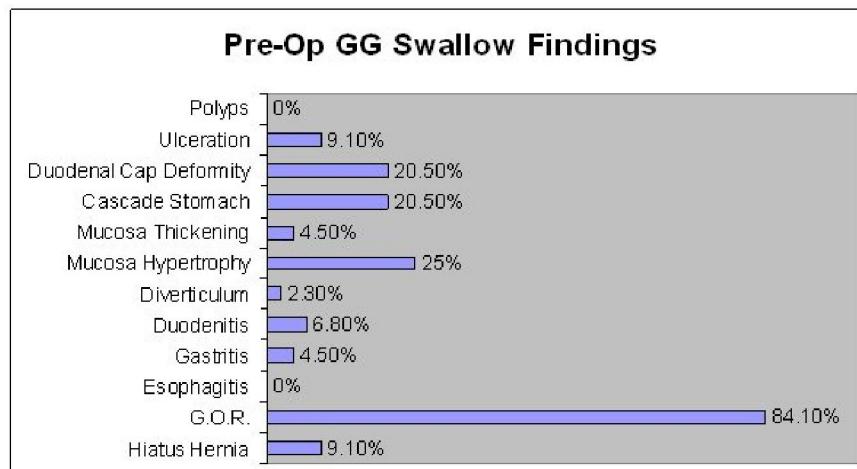
**Figure 3:** Pre-operative Gastrografin Swallow:  
Stomach



**Figure 4:** Post-operative Gastrografin swallow



**Figure 5:** Fluoroscopic tightening of band



**Figure 6:** Pre-operative Gastrografin Swallow Examination Findings

**Table 1:** Post-operative complications

Complications	No. of Patients	Time From Surgery
Stenosis	3	5, 5, 18 Months
Esophageal Distension	1	5 Months
Infection	1	1 Week
Bolus Impaction	1	14 Months
Port Malposition	1	8 Months

#### 4.Discussion

Out of the sixty-four patients scheduled for the surgery and participating in this study, three were not operated on; two patients cancelled and the liver of the third patient was too enlarged to allow the surgeons to complete the surgery. A similar condition was found in another patient; however, the surgery was switched from a laparoscope method to an open surgery due to the enlarged liver. This gives a total of sixty-one patients who underwent the surgery; sixty of them via laparoscope and one via open surgery. Of these sixty-one patients, only forty-four of them had available reports of their pre-operative Gastrografin Swallow examinations.

The findings of the patients' pre-operative Gastrografin Swallow examinations varied from completely normal to conditions severe enough to require treatment before proceeding with the surgery. Four patients (9.1%) were found to have hiatus hernias, only one of which, however, was large enough to require treatment before surgery. Obesity is considered a risk factor of developing hiatus hernias<sup>8</sup>. Thirty-seven patients were noted to have Gastroesophageal reflux (84.1%). Gastroesophageal reflux (GOR) was by far the most reported pre-operative finding in our group of patients. The extra

abdominal weight that obese patient's carry affect the work of the sphincter at the gastroesophageal junction. It is no longer as efficient and becomes somewhat lax, allowing gastric acids to flow up the esophagus creating GOR. Studies have suggested a correlation between obesity and GOR<sup>9</sup>.

No patients were found to have esophagitis although 4.5% patients were found to have gastritis, 6.8% were found to have duodenitis, 9.1% patients were reported to have ulcerations, and 2.3% patient had a diverticulum. Studies have indicated that ulcerations and inflammations of the GI tract are associated with the increase of the BMI<sup>10</sup>. It has also been scientifically found that fat cells stimulate local immune responses thus leading to inflammation<sup>11</sup>.

As far as the anatomy goes; 41% of patients reported to have cascade stomachs and slight deformities of the duodenal cap, 25% were reported to have hypertrophy of the mucosa and only 4.5% were reported to have thickening of the mucosal wall. Cascade stomachs are considered to be congenital conditions and, therefore, cannot be directly linked to obesity.

During the post-operative Gastrografin Swallow examination one day after the surgery, no patients were found to have perforations. Six patients out of the sixty-one had complications. Three patients developed stenosis and were admitted to the ER with symptoms including vomiting, dysphagia and abdominal pain. The stenosis was reversed by aspirating fluid from the gastric band, thus loosening them. One of these three patients additionally developed slight esophageal distension. One patient developed an infection a week after the surgery and was treated with antibiotics. One patient had an impaction of bolus at the gastroesophageal junction. Malposition is a condition in which the port flips over and faces the opposite direction, thus making it

impossible to access and therefore control the size of the gastric band. There was one patient with this complication who underwent surgery to reposition the port correctly.

### Conclusion

Adjustable Gastric Banding (AGB) is a relatively low-risk and low invasiveness treatment alternative for morbid obesity. It has the advantages of reversibility as well as adjustability. Radiology plays a key role in the pre-operative screening of AGB patients. It also plays a significant role in detecting postoperative complications.

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