Obesity Surgery (2019) 29:1704–1708
https://doi.org/10.1007/s11695-019-03777-9

ORIGINAL CONTRIBUTIONS

# Routine Upper Gastrointestinal Fluoroscopy Before Laparoscopic Sleeve Gastrectomy: Is It Necessary?

Ido Mizrahi[1] · Ala'a Abubeih[1] · Jacob Rachmuth[1] · Yevgeni Plotkin[1] · Nahum Beglaibter[1] · Ronit Grinbaum[1] · Ithamar Greenstein[1] · Naama Lev Cohain[2]

Published online: 22 February 2019


## Abstract

**Background** Controversy exists regarding the clinical utility of routine preoperative upper gastrointestinal (GI) fluoroscopy in morbid obese patients undergoing laparoscopic sleeve gastrectomy (LSG). The aim of our study was to determine the efficacy of these studies in detecting hiatal hernias (HH).

**Methods** The institution's prospectively maintained, IRB-approved database was retrospectively queried to identify all consecutive patients who underwent LSG between 2011 and 2017. All patients underwent routine preoperative upper GI fluoroscopy. Reports from all imaging studies were retrospectively reviewed and compared to the presence of an intraoperative HH.

**Results** During the study period, a total of 1810 patients (854 males, 956 females) underwent LSG at our institution. Mean age was 40.95 ± 13 years (range 11–75), and mean BMI was 42.8 ± 5 kg/m$^2$ (range 30–86). The overall prevalence of HH was 11.1% (201 patients). All HHs detected were repaired. Considering the intraoperative identification of HH the gold standard for diagnosis, the sensitivity and specificity of preoperative UGI fluoroscopy for HH detection were 32% (66/201) and 94% (1512/1609), respectively. The median operative time was significantly longer when concomitant LSG and HH repair was performed compared to LSG alone (76 min vs. 55 min, $p < 0.001$, respectively). The foreknowledge of HH had no influence on the median operative times (77 min vs. 75 min, predicted vs. incidental, respectively, $p = 1.34$). HH repair did not affect the complication rate ($p = 0.3$).

**Conclusion** Routine preoperative upper GI fluoroscopy holds a low sensitivity for HH detection. Health policy regulators should consider omitting this exam from routine preoperative evaluation for bariatric patients.

**Keywords** Laparoscopic sleeve gastrectomy · Upper gastrointestinal fluoroscopy · Swallow study · Preoperative · Hiatal hernia

## Introduction

Since the beginning of the new millennium, laparoscopic sleeve gastrectomy (LSG) has grown in popularity worldwide [1]. In fact, LSG was the most common bariatric procedure performed worldwide during 2018 [2]. Furthermore, in short- and mid-term follow-up, LSG has the lowest procedure-related morbidity compared with laparoscopic 'Roux-en-y' gastric bypass (LRYGB) and laparoscopic adjustable gastric banding (LAGB) [3].

✉ Ido Mizrahi
idomiz@hadassah.org.il

Ala'a Abubeih
abubeih@hadassah.org.il

Jacob Rachmuth
kobirachm@walla.co.il

Yevgeni Plotkin
yevgenip@gmail.com

Nahum Beglaibter
bnahum@hadassah.org.il

Ronit Grinbaum
ronitgr@hadassah.org.il

Ithamar Greenstein
ithamar.greenstein@mail.huji.ac.il

Naama Lev Cohain
NAAMAL@HADASSAH.ORG.IL

[1] Department of Surgery, Hadassah-Hebrew University Medical Center, P.O. Box 24035, Mount Scopus, 91240 Jerusalem, Israel

[2] Department of Radiology, Hadassah-Hebrew University Medical Center, Mount Scopus, Jerusalem, Israel

Hiatal hernia (HH) is a common condition in bariatric patients with rates ranging from 9 to 37% in different reports [4–7]. Simultaneous HH repair and LSG are safely and routinely performed in most centers [8–10]; however, its presence imposes difficulty in performing LSG. Accurate identification of the gastroesophageal junction (GEJ) in the presence of HH during LSG is crucial, as failure to correctly identify and repair it can potentially expose the patient to reflux and esophagitis.

For the abovementioned reason, routine upper gastrointestinal (GI) evaluation has become a pillar in preoperative evaluation, by either fluoroscopy or endoscopy. In fact, a directive issued by the Israeli ministry of health mandates a uniform pre-bariatric surgery series of tests, including upper GI fluoroscopy for all candidates while upper GI endoscopy is more selectively ordered and is not considered mandatory (https://www.health.gov.il/hozer/mr27_2017.pdf, https://www.health.gov.il/hozer/mr33_2013.pdf). Despite mandatory preoperative upper GI evaluation, incidental HH is often found intraoperatively, whereas in some patients, the preoperative fluoroscopic barium swallow study results are false positive, and a HH is not found during hiatal exploration [4].

The primary aim of this study was to evaluate the accuracy of routine preoperative upper GI fluoroscopic swallow studies in identifying HH during LSG. The secondary aims were to determine if such foreknowledge had an impact on operative time, intraoperative adverse events, and postoperative course.

## Methods

The institution's prospectively maintained Institutional Review Board (IRB)-approved database was retrospectively queried for all patients who underwent LSG between January 2011 and December 2017. Data collected included demographic and anthropometric information, co-morbidities, operative, and immediate postoperative course. All patients had an upper GI fluoroscopic barium swallow study as part of their routine preoperative work-up. A government-subsidized health maintenance organization (HMO) is provided for all citizens and completes all preoperative testing, and thus, upper GI swallow studies were performed by different diagnostic imaging centers, as provided by the individual HMOs. Reports and images from all imaging studies were retrospectively reviewed and compared to the presence of an intraoperative HH. The IRB waived the requirement for informed consent.

Operative technique for this procedure has been previously described [11]. Sleeve gastrectomies were fashioned using multiple stapler firings, beginning 4 cm proximal to the pylorus along a 36 Fr bougie. Prior to gastric partitioning, a meticulous hiatal exploration was performed to identify the presence of an HH. All HHs were repaired via posterior approach with non-absorbable interrupted sutures. An intra-operative leak test using methylene blue injection was performed. Over-suturing of the staple line was selectively performed for hemostasis. A closed suction drain was placed in proximity to the gastric staple line. All procedures were performed by two expert minimally invasive bariatric surgeons.

For all patients, the postoperative care followed a standardized protocol. Liquid diet was started on post-operative day (POD) 2 and patients were discharged on POD 3. After hospital discharge, patients were followed at the bariatric surgery clinic by our multidisciplinary bariatric team, at 10 days, 3, 6, and 12 months, and yearly thereafter. Complications were graded according to the Clavien-Dindo classification [12].

Statistical analysis was completed using statistical software SPSS version 20 (SPSS, Inc., Chicago, IL), and a $p$ value $< 0.05$ was considered to represent statistical significance for all comparisons. Continuous variables are described as mean ± standard deviation and range and were compared by using Student's $t$ test. Categorical variables are described using frequency distributions and are presented as frequency (%). Categorical variables were compared using the Chi square or Fisher's exact test as necessary.

## Results

During the study period, a total of 1810 patients (854 males, 956 females) underwent LSG at our institution. Mean age was 40.95 ± 13 years (range 11–75), and mean BMI was 42.8 ± 5 kg/m$^2$ (range 30–86). Patient characteristics and co-morbidities are shown in Table 1.

All patients underwent a pre-operative upper GI fluoroscopic barium swallow study, and an HH was detected in 163 patients (9%) with equal gender distribution. Of these

**Table 1** Patient characteristics

| | Total | Gender | | |
|---|---|---|---|---|
| | | Male (%) | Female (%) | *P* |
| Total *N* (%) | 1810 (100) | 854 (47.2) | 956 (52.8) | |
| BMI (kg/m$^2$), mean | 42.86 | 42.86 | 42.85 | 0.977[a] |
| Age (years), mean | 40.95 | 41 | 41 | 0.287[a] |
| Co-morbidities | | | | |
| DM *n* (%) | 504 | 253 (29.6) | 251 (26.3) | 0.110[b] |
| HTN *n* (%) | 551 | 254 (29.7) | 297 (31.1) | 0.541[b] |
| HPL *n* (%) | 663 | 315 (36.9) | 348 (36.4) | 0.831[b] |
| GERD *n* (%) | 80 | 40 (4.7) | 40 (4.2) | 0.606[b] |
| OSA *n* (%) | 305 | 146 (17.1) | 159 (16.6) | 0.792[b] |

[a] Independent sample $t$ test with equal variances assumed

[b] Pearson's Chi-square test

Percentages are from male and female groups

163 patients, an HH was found and repaired in 66 patients (33%). Of the 1647 patients with a negative preoperative upper GI evaluation, 135 were found to have an intra-operative HH (8.2%), which was repaired. Thus, all hiatal hernias detected during surgery ($n = 201$) were repaired.

Considering the intra-operative identification of an HH as the gold standard for diagnosis, the sensitivity of pre-operative upper GI swallow study for HH detection was 66/201 (33%), specificity 1512/1609 (94%), positive-predictive value 66/163 (40.5%), and negative-predictive value 1512/1647 (91.8%) (Table 2). The prevalence of HH in the entire cohort was 11.1% (201/1810).

Thirty-four patients (1.8%) underwent a pre-operative upper endoscopy, 12 of whom were diagnosed with HH per endoscopy. Four of these 12 patients (33%) were found to have a HH intra-operatively.

The cost of a single UGI fluoroscopy study is approximately $249. Thus, the total cost of UGI studies performed during our study's period was $450,690.

The median operative time was significantly longer in patients in whom an HH was repaired, compared to patients who underwent LSG alone (76 min versus 55 min, $p < 0.001$, respectively). In patients who underwent HH repair, the foreknowledge of an HH had no influence on the median operative times (predicted HH 77 min versus incidental HH 75 min, $p = 1.34$).

When an HH was expected, according to a positive UGI Barium study, and therefore actively looked for, median operative times were longer than when the bariatric procedure was performed without hiatal exploration (66 min versus 57 min, $p < 0.001$, respectively).

As shown in Table 3, all of the obesity-related co-morbidities collected significantly correlated with the presence of an HH.

Table 4 presents post-operative complications according to the Clavien-Dindo classification. Hiatal hernia repair did not affect the complication rate ($p = 0.3$). Major complications (Clavien-Dindo grade 3–4) occurred in 15 patients (0.8%) including leak (0.45%) and bleeding (0.4%). No mortality was recorded.

**Table 2** Cross-tabulation for pre-operative swallow study and intra-operative HH detection

| | | Intra-operative HH | | Total |
|---|---|---|---|---|
| | | No | Yes | |
| Preoperative UGI Hernia | No | 1512<br>TN | 135<br>FN | 1647 |
| | Yes | 97<br>FP | 66<br>TP | 163 |
| Total | | 1609 | 201 | 1810 |

*UGI* upper gastrointestinal, *HH* hiatal hernia, *TN* true negative, *FN* false negative, *FP* false positive, *TP* true positive

**Table 3** Co-morbidities correlation to intra-operative HH

| | | HH (−) | HH (+) | *P* |
|---|---|---|---|---|
| Gender | Male | 755 (46.9) | 99 (49.3) | 0.533 |
| | Female | 854 (53.1) | 102 (50.7) | |
| GERD | | 58 (3.6) | 22 (10.9) | < 0.001 |
| DM | | 431 (26.8) | 73 (36.3) | 0.004 |
| HTN | | 463 (28.8) | 88 (43.8) | < 0.001 |
| OSA | | 260 (16.2) | 45 (22.4) | 0.026 |
| HPL | | 563 (35.0) | 100 (49.8) | < 0.001 |
| Preoperative UGI hernia | | 97 (6.0) | 66 (32.8) | > 0.001 |

All results are presented as *n* (%)

## Discussion

In our cohort of 1810 patients, hiatal hernia was suspected based on pre-operative upper GI fluoroscopy in 9%, whereas the actual prevalence of HH found intra-operatively was 11%. Similarly, Goiten et al., in their cohort of 2417 patients, showed that based on pre-operative upper GI fluoroscopy, HH presence was suggested in 9% of patients while the actual prevalence of HH found intra-operatively was 7.3% [4]. Soricelli et al. detected an HH pre-operatively in 11% of patients and HH were intra-operatively repaired in 14.5% [13]. Higher rates were reported by Che et al. showing the presence of a hiatal hernia in nearly 40% of morbidly obese patients based on upper GI fluoroscopy [14].

The sensitivity of pre-operative upper GI fluoroscopy for HH detection in our patients was 33% (66/201). Goiten et al. reported a similar low sensitivity rate of 36% (65/177) for the detection of HH based on fluoroscopy before LSG [4]. Fornari et al. showed equal sensitivity of 33% (30/93) for HH detection in morbid obese patients subjected to gastric bypass [15]. Even lower sensitivity rates were shown by Sharaf et al., with upper GI fluoroscopy in 171 patients before various bariatric procedures, which detected 5.3% clinically relevant findings [16].

**Table 4** Post-operative complications (Clavien-Dindo classification)

| | HH (−) $N = 1609$ | HH (+) $N = 201$ | *p* |
|---|---|---|---|
| Minor complications grades I and II | | | |
| Superficial SSI | 9 | 2 | .3 |
| Urinary | 15 | 3 | .4 |
| Cardiac | 7 | 0 | 1 |
| Bleeding | 15 | 4 | .4 |
| Major complications grades III and IV | | | |
| Leak | 7 | 1 | .5 |
| Bleeding | 7 | 0 | 1 |

In our experience, simultaneous LSG and HH repair did not affect the complication rate and we therefore consider it clinically appropriate for this patient population. Such repair prolonged the operation by 21 min. Interestingly, no difference in operative time was found when HH was predicted by fluoroscopy versus when it was incidentally found. Several authors reported on the safety and efficacy of simultaneous LSG and HH repair. Mahawar et al. published a systematic review of simultaneous LSG and HH repair, concluding it is a safe and acceptable procedure for bariatric patients [8]. In the fifth international consensus conference on sleeve gastrectomy, 84% of expert bariatric surgeons agreed that HH should be looked for with identification maneuvers along the left diaphragmatic crus and should be repaired, if found. Furthermore, most expert bariatric surgeons (88%) considered the presence of a HH by itself not to be a contraindication to perform LSG [1].

Considering the relatively low prevalence of HH in bariatric patients and the low sensitivity of pre-operative UGI fluoroscopy in detecting these HH, the authors question the clinical utility of routine and mandatory pre-operative upper GI fluoroscopy before LSG. Proponents of pre-operative UGI fluoroscopy argue that the imaging obtained may help in pre-operative planning; however, in our cohort, the foreknowledge of HH detected by fluoroscopy did not affect operative times, surgical planning, or the complication rate. Goiten et al. showed in their study that only the presence of gastroesophageal reflux disease (GERD) was predictive of HH presence [4]. We have previously shown a higher prevalence of HH in patients older than 60 years [17]. Thus, some may advocate a more tailored pre-operative work-up only for elderly patients or those who present with GERD.

Pre-operative upper GI endoscopy is not mandatory in our country and is selectively ordered when the bariatric surgeon suspects an upper GI pathology such as Barrett's esophagus, peptic ulcer disease, etc. Moreover, our ministry of health allows only gastroenterologists to perform endoscopies, so the surgeon has less influence on endoscopy scheduling. For the above reasons, only 34 of 1810 patients (1.8%) in our cohort underwent a pre-operative upper endoscopy precluding a statistically valid comparison. Twelve patients were diagnosed with an HH per endoscopy and only four patients (33%) were found to have an HH intra-operatively. Our selective approach to pre-operative endoscopy is supported by two recently published systematic reviews and meta-analysis studying the role of routine preoperative endoscopy in bariatric surgery concluding that in average-risk, asymptomatic patients, endoscopy should be considered optional, as the proportion of endoscopies that resulted in important changes in management was low [18, 19].

The cost of UGI fluoroscopy studies per year during our study period was $64,384. Health system regulators worldwide should reevaluate the true value of these studies considering their low sensitivity and negligible clinical impact during LSG, possibly saving their countries health care unnecessary expenditure.

The retrospective observational nature of this study has its obvious limitations regarding selection bias. Other limitations include the lack of a control group and the fact that preoperative UGI fluoroscopy studies were performed as stated above at different radiology centers.

## Conclusions

Routine preoperative UGI fluoroscopy holds a low sensitivity for HH detection and does not seem to offer an advantage over intraoperative hiatal exploration in patients undergoing LSG. Health policy regulators should consider omitting this exam from routine preoperative work up, saving time and reducing radiation exposure for the patient, saving money for health care systems, and avoiding unnecessary burden on radiology centers.

**Funding** The authors did not receive any form of funding for this study.

### Compliance with Ethical Standards

The institution's prospectively maintained Institutional Review Board (IRB)-approved database was retrospectively queried for all patients who underwent LSG between January 2011 and December 2017.

**Conflict of Interest** The authors declare that they have no conflict of interest.

Author 1, author 2, author 3, author 4, author 5, author 6, author 7, and author 8 declare there was no financial support or potential conflicts of interest in preparing this manuscript.



## References

1. Gagner M, Hutchinson C, Rosenthal R. Fifth international consensus conference: current status of sleeve gastrectomy. Surg Obes Relat Dis. 2016;12:750–6.
2. Welbourn R, Hollyman M, Kinsman R, et al. Bariatric surgery worldwide: baseline demographic description and one-year outcomes from the fourth IFSO global registry report 2018. Obes Surg. 2018; https://doi.org/10.1007/s11695-018-3593-1.
3. Fridman A, Moon R, Cozacov Y, et al. Procedure-related morbidity in bariatric surgery: a retrospective short- and mid-term follow-up of a single institution of the American College of Surgeons bariatric surgery centers of excellence. J Am Coll Surg. 2013;217:614–20.
4. Goitein D, Sakran N, Rayman S, et al. Barium swallow for hiatal hernia detection is unnecessary prior to primary sleeve gastrectomy. Surg Obes Relat Dis. 2017;13:138–42.
5. Sharaf RN, Weinshel EH, Bini EJ, et al. Radiologic assessment of the upper gastrointestinal tract: does it play an important preoperative role in bariatric surgery? Obes Surg. 2004a;14:313–7.

6. Che F, Nguyen B, Cohen A, et al. Prevalence of hiatal hernia in the morbidly obese. Surg Obes Relat Dis. 2013a;9:920–4.
7. Muñoz R, Ibáñez L, Salinas J, et al. Importance of routine preoperative upper GI endoscopy: why all patients should be evaluated? Obes Surg. 2009;19:427–31.
8. Mahawar KK, Carr WR, Jennings N, et al. Simultaneous sleeve gastrectomy and hiatus hernia repair: a systematic review. Obes Surg. 2015;25:159–66.
9. Pham DV, Protyniak B, Binenbaum SJ, et al. Simultaneous laparoscopic paraesophageal hernia repair and sleeve gastrectomy in the morbidly obese. Surg Obes Relat Dis. 2014;10:257–61.
10. Samakar K, McKenzie TJ, Tavakkoli A, et al. The effect of laparoscopic sleeve gastrectomy with concomitant hiatal hernia repair on gastroesophageal reflux disease in the morbidly obese. Obes Surg. 2016;26:61–6.
11. Rosenthal RJ, Diaz AA, Arvidsson D, et al. International sleeve gastrectomy expert panel consensus statement: best practice guidelines based on experience of >12,000 cases. Surg Obes Relat Dis. 2012;8:8–19.
12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205–13.
13. Soricelli E, Iossa A, Casella G, et al. Sleeve gastrectomy and crural repair in obese patients with gastroesophageal reflux disease and/or hiatal hernia. Surg Obes Relat Dis. 2013;9:356–61.
14. Che F, Nguyen B, Cohen A, et al. Prevalence of hiatal hernia in the morbidly obese. Surg Obes Relat Dis. 2013b;9:920–4.
15. Fornari F, Gurski RR, Navarini D, et al. Clinical utility of endoscopy and barium swallow X-ray in the diagnosis of sliding hiatal hernia in morbidly obese patients: a study before and after gastric bypass. Obes Surg. 2010;20:702–8.
16. Sharaf RN, Weinshel EH, Bini EJ, et al. Radiologic assessment of the upper gastrointestinal tract: does it play an important preoperative role in bariatric surgery? Obes Surg. 2004b;14:313–7.
17. Mizrahi I, Alkurd A, Ghanem M, et al. Outcomes of laparoscopic sleeve gastrectomy in patients older than 60 years. Obes Surg. 2014;855-60(24442420):24.
18. Bennett S, Gostimir M, Shorr R, et al. The role of routine preoperative upper endoscopy in bariatric surgery: a systematic review and meta-analysis. Surg Obes Relat Dis. 2016;12:1116–25.
19. Parikh M, Liu J, Vieira D, et al. Preoperative endoscopy prior to bariatric surgery: a systematic review and meta-analysis of the literature. Obes Surg. 2016;26:2961–6.