Surgical Endoscopy (2019) 33:2231–2234
https://doi.org/10.1007/s00464-018-6509-1

Conversion for failed adjustable gastric banding warrants hiatal scrutiny for hiatal hernia

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Received: 29 June 2018 / Accepted: 11 October 2018 / Published online: 19 October 2018

Abstract

Background Failure or complications following laparoscopic adjustable gastric banding (LAGB) may necessitate band removal and conversional surgery. Band position and band-induced chronic vomiting create ideal conditions for de novo hiatal hernia (HH) formation. HH presence impedes and complicates conversional surgery by obscuring crucial anatomical landmarks and hindering precise gastric sleeve or pouch formation. The aim of this study was to evaluate the incidence of a HH in patients with an LAGB undergoing conversion compared to patients undergoing primary bariatric surgery (BS).

Methods Retrospective review of consecutive BS performed between 2010 and 2015. Data collected included demographics, anthropometrics, comorbidities, previous BS, preoperative and intra-operative HH detection, operation time, perioperative complications and length of hospital stay.

Results During the study period, 2843 patients (36% males) underwent BS. Of these, 2615 patients (92%) were "primary" (no previous BS—control group), 197 (7%) had a previous LAGB (study group), and 31 (1%) had a different previous BS and were excluded. Reasons for conversion included weight regain, band intolerance and band-related complications. Mean age and body mass index were similar between the study and the control groups. HH was preoperatively diagnosed by upper gastrointestinal (UGI) fluoroscopy in 9.1% and 9.0% of the LAGB and control groups (p = NS), respectively. However, HH was detected intra-operatively in 20.3% and 7.3%, respectively ($p < 0.0001$).

Conclusions Preoperative diagnosis of a HH by UGI fluoroscopy for patients who have undergone LAGB is unreliable. Intra-operative hiatal exploration is highly recommended in all cases of conversional BS after LAGB.

Keywords Laparoscopic adjustable gastric banding · UGI fluoroscopy · Hiatal hernia · Diaphragmatic hernia · Sleeve gastrectomy · Roux-Y gastric bypass · Conversional surgery

Laparoscopic adjustable gastric banding (LAGB) is performed worldwide as an acceptable bariatric procedure, mainly due to its relative technical simplicity and superior safety profile. It boasts minimal perioperative complications and very low mortality rates, when compared to the more aggressive options of laparoscopic sleeve gastrectomy (SG), Roux en Y gastric bypass (RYGBP) and biliopancreatic diversion (BPD/DS) [1–3]. Though the short-term effect on obesity and associated comorbidities is acceptable, long-term effects seem to be unsatisfactory. When compared with other bariatric procedures like SG and RYGBP, LAGB remains sub-optimal with various band-associated complications, including spontaneous proximal dilation [4–6]. With increasing reports of LAGB failure, along with decreasing complication rates of SG and RYGBP, the popularity of LAGB has rapidly declined [1]. Nonetheless, some authors

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report adequate long-term weight loss and comorbidity resolution [7]. Still, there are numerous patients worldwide who underwent LAGB and are at risk of its late complications. Band removal with or without subsequent conversion to a different bariatric surgery (BS) is quite common [8–10]. In performing conversions, identification of anatomical landmarks such as the gastro-esophageal junction (GEJ) and the diaphragmatic crura is crucial for proper sleeve or gastric pouch formation. Hiatal hernia (HH), which is highly prevalent in the bariatric population at large and even more so in post-LAGB patients [11], may impair adequate exposure and correct identification of such critical landmarks [12]. In the presence of a "missed" HH, it is not possible to correctly follow the anatomical landmarks as part of the proximal stomach, usually with the GEJ, has slid up into the mediastinum. Thus—gastric partitioning may be performed at an incorrect location, leaving the GEJ and part of the gastric fundus above a misconstructed sleeve or gastric pouch [12]. This, in turn, can lead to failure of the conversion with upper sleeve, or pouch dilation or causing a substantial decrease of the weight loss effect of BS [13, 14]. Correct positioning of the band places it abutting the diaphragmatic crura. That, with a common course of post-band vomiting creates an "ideal" situation for de novo HH occurrence.

Previously published data regarding the link between the presence of HH and LAGB have shown a small subset of patients having newly formed HH after LAGB placement [11].

The aim of this study was to evaluate the incidence of a HH in patients with LAGB failure undergoing conversion compared to patients undergoing primary BS.

Methods

Retrospective analysis of a prospectively maintained database of all BS performed between 2012 and 2015. Data collected included demographic, anthropometric, obesity-related comorbidities, previous BS, preoperative HH workup, operative and immediate postoperative course. In patients with a previous BS, the indication for conversion was documented as well.

All patients underwent preoperative upper gastrointestinal (UGI) series. A directive issued by the Israeli ministry of health mandates a uniform pre-BS series of tests, including an upper GI fluoroscopy for all candidates. A government-subsidized health maintenance organization (HMO) is provided for all citizens and completes all preoperative testing, and thus, upper GI evaluation was performed by different diagnostic imaging centers, as provided by the individual HMOs. Surgical technique for both SG and RYGB was as previously described [15]. In both, care was taken to completely expose the left crus of the diaphragm. When coupled with band removal, the right crus was also exposed by opening the pars flaccida. A 1–2-cm strip of the inner capsule was removed following band removal. Exposure of both crura was also performed when a HH was detected in the preoperative UGI and in the presence of GERD. A HH was intraoperatively diagnosed by careful scrutiny of the exposed (but undisturbed) hiatus when a frank opening or distinct indentation was observed. Only if an HH was seen, the peritoneum alongside the crura was opened and the hernia repaired. This consisted of complete mobilization and reduction in the hernia sac, stomach, associated lipoma (when present), and distal esophagus until the GEJ was returned to the abdominal cavity (at least 3 cm, without retraction). The vagus nerve was visualized and conserved. The crural defect was suture-closed after sleeve formation over a 32–34F bougie, using a nonabsorbable, braided suture. Anterior and/or posterior closure was utilized according to surgeon preference [12].

Statistical analysis

A statistician (Mr. S. Arad), who is a part of the Assia Medical Group, performed statistical review of the methods, as well as all statistical analyses of the data. Continuous variables were compared by using Student's *t* test. Categorial variables were compared using the Chi-square, or Fisher's exact test as necessary. All tests were 2-tailed and considered significant at $p = 0.05$. Calculations were done using the SPSS software.

This study was approved by the institutional review board, and all patients signed an approved informed consent form.

Results

During the study period, 2843 patients (1026 males; 36%) underwent SG or RYGBP. Of these, 31 patients had various previous BS other than LAGB and were excluded (1.1%). One hundred and ninety-seven patients (6.9%) had a previous LAGB and comprised the study group. The control group consisted of the remaining patients (2615, 92.0%). Within the study group, 152 underwent SG and 45 underwent RYGBP. In the control group, 2482 underwent SG and 133 underwent RYGBP. The body mass index (BMI) and mean age of the study and control groups were 43.9 ± 6.5 versus 42.7 ± 5.2 kg/m^2, and 43.1 ± 10.8 versus 43.2 ± 11.6 years, respectively (p = NS). Males were significantly older (44.3 ± 11.2 versus 42.3 ± 11.6; $p < 0.0001$). GERD was significantly higher in patients with a previous LAGB (study group, $n = 47$; 23.8%) versus patients undergoing primary BS (control group $n = 477$, 16.7%; $p < 0.05$) (Table 1). The indications for LAGB conversion were weight regain ($n = 153$, 77.6%), band intolerance ($n = 38$, 19.2%) and band r-lated complications ($n = 21$,

Table 1 Comorbidity profile of patients

	All cohort $n=2843$ (%)	Study group $n=197$ (%)	Control group $n=2615$ (%)	p value
T2D n (%)	839 (29.5)	48 (24.4)	786 (30.1)	NS
OSA n (%)	551(19.4)	33 (16.8)	515 (19.7)	NS
GERD n (%)	533 (18.3)	47 (23.9)	477 (18.2)	$p<0.05$
HTN n (%)	840 (29.6)	52 (26.4)	785 (30.0)	NS
Chol n (%)	1476 (51.9)	97 (49.2)	1372 (52.5)	NS

T2D type 2 diabetes mellitus, *OSA* obstructive sleep apnea, *GERD* gastro-esophageal reflux disease, *HTN* hypertension, *Chol* dyslipidemia, *NS* nonstatistically significant

Table 2 Efficacy of barium swallow studies in diagnosis of hiatal hernia

	All cohort $N=2843$ (%)	Control group $n=2615$ (%)	Study group $N=197$ (%)
Sensitivity	36.4	40.3	17.5
Specificity	93.5	93.5	93.0
PPV	33.7	32.9	38.9
NPV	94.2	95.2	81.6

PPV positive predictive value, *NPV* negative predictive value

10.6%). Mean weight loss since LAGB at the time of conversion was 32.6 ± 17.7 kg. Since the vast majority of the study group had their LAGB at other institutions, there is no reliable data regarding weight nadir (Kg or time from surgery).

The mean time and median time between LAGB placement and the conversion were 7.44 and 7 years (range 1–17 years), respectively. Fifty-six patients (28.4%) had their LAGB removed before the conversional surgery and 141 (71.6%) had concomitant LAGB removal and conversional surgery. HH was found in 7 of 56 (12.5%) patients that had their band removed previously and in 34 of 141 (24.1%) who had concomitant surgery ($p=0.08$). Preoperative, fluoroscopic "diagnosis" of HH was present in 252 (9.0%) patients, 18 patients in the study and 234 patients in the control group (9.1% vs. 9.0%, respectively, $p=$NS). A negative preoperative UGI was found in 2381(91%) and 179 (90%) patients of the control and study groups, respectively. Of these, 356 (13%) and 37 (18%) had previous GERD symptoms ($p=$NS). The incidence of HH found and repaired intra-operatively in this subset of patients (preoperative GERD and negative preoperative UGI) was 19 (0.79%) and 11 (5.58%) in the control and study groups, respectively ($p<0.05$).

Of the entire cohort, 231 patients (8.1%) had a confirmed HH, which was repaired intra-operatively. They consisted of 40 patients in the study group and 191 patients in the control group (20.3% vs. 7.3%, respectively, $p<0.001$, OR 3.2, CI 2.2–4.7). Sensitivity and positive predictive value of preoperative UGI series in diagnosis of HH were 17.5% and 38.9% in the study group and 40.3% and 32.9% in the control group, respectively (Table 2).

There were no immediate postoperative complications related to the capsular dissection or HH repair such as bleeding, dysphagia or leaks.

Discussion

LAGB has a high safety profile with long-term adequate weight reduction and reduced adverse effects [7]. Nonetheless, in recent years LAGB has fallen out of favor compared to other primary BS procedures worldwide [16]. Conversional surgery after this procedure is common and will likely increase in coming years. Lazzati and co-workers have shown that 40% of bands are removed within 7 years of insertion, and more than two-thirds of patients eventually require conversion [9]. Victorzon and colleagues reported a reoperation rate of 63%, 14 years following surgery [10].

HH is present in 11–37% of patients undergoing BS, and its presence negatively influences proper formation of both SG and GB [12]. There is an inherent alteration of anatomy and physiology after LAGB, some of which may contribute to de novo HH formation. First, disruption of the hiatal area during band placement and subsequent inflammation and remodeling may weaken the hiatus. Second, recurrent vomiting, which usually presents early after insertion and continues in cases when the gastric band is maladjusted, causes elevated intra-abdominal pressures and direct compression of the GEJ to the hiatus. Unfortunately, maladjusted bands are not uncommon. Third, pseudo-achalasia and proximal gastric pouch dilation are present in some post-LAGB patients and are directly implicated in HH formation [4, 11, 17].

Similar to previous reports, we found that a previous LAGB is a definite risk factor for HH presence. Unfortunately, preoperative UGI series gives unacceptable false negative and positive results. Azagury and co-workers found that UGI studies failed to demonstrate such HH preoperatively [11]. Our experience with this modality supports the observation that UGI is of limited value in diagnosing a HH preoperatively. Only 18 patients of the study group were diagnosed with a HH preoperatively, compared to the 40 patients that were found to have a HH intra-operatively (9.1% vs. 20.3%, $p<0.001$).

In our cohort, we found that HH is over 3 times more likely to be found in a patient with a previous LAGB than in a patient undergoing primary BS (OR 3.2, CI 2.2–4.6). The sensitivity of the UGI to rule out a HH in the study group was even lower when compared to the control group, with a sensitivity of 17% versus 40%, respectively.

The only comorbidity that was significantly more prevalent in the study group was GERD (23.8% vs. 18.3%,

$p = 0.05$), which correlates with the presence of GERD being predictive of HH presence [RR 1.11 (95% CI = 1.1–1.2); $p = 0.0001$]. Unlike some of previously published data in which the indication for conversional surgery for LAGB was reflux, in our study the indication for conversions was due to LAGB failure (weight regain 77%, band intolerance 19% and band complication 10.6%).

Limitations of this study include its inherent observational, retrospective design. Another limitation is the quality of UGI study interpretation, which was performed by different diagnostic imaging centers, as provided by the individual HMOs, and not in a single dedicated bariatric center. It is possible that the radiologists who read these studies were less experienced in evaluating imaging in the setting of a gastric band. Also, there is limited data regarding the study group at the time of initial band placement so we have no data regarding the effort taken to look for and document HH presence at that time. Notably, without certain knowledge whether a HH was present at the time of LAGB procedure, we cannot confidently conclude that LAGB is definitely causative of the HH identified at the time of revisional BS. Furthermore, various surgeons, at different hospitals with various techniques and band types, performed the initial LAGB. This might also influence the rate of HH formation. However, the main "take home message" of this study, mainly that in patients undergoing BS with a history of LAGB an HH should actively be looked for. The time between band placement and removal might also influence the rate of HH formation. Unfortunately, our study is underpowered to assess for this variable. GERD diagnosis was made symptomatically (history + PPI use) and further invasive investigative modalities were performed in select cases as per the operating surgeon's preference.

Conclusion

As preoperative diagnosis of a HH by UGI series for patients with a previous LABG is unreliable, intra-operative hiatal exposure and scrutiny are highly recommended in all cases of conversional BS after LAGB.

Compliance with ethical standards

Disclosures Drs. S. Rayman, M. Goldenshluger, O. Goitein, J. Dux, N. Sakran, A. Raziel and D. Goitein have no financial or commercial conflicts of interest to disclose.

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