Should adjustable gastric band be abandoned as a bariatric surgery option? Private center’s experience with adjustable gastric band conversion.

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Abstract

Background:

The literature is lacking experience of revising adjustable gastric band at private centers in Saudi Arabia.

Methods:

A retrospective review at a private hospital was conducted. Primary endpoints were weight loss after 1 year, operative time, and complications. Conversion patients were matched with similar patient subjected to primary BS in a 1:2 ratio.

Results:

Twenty six patients were managed in a single stage conversion of AGB to laparoscopic sleeve gastrectomy (LSG). One third of the patients had weight regain (WR) and band intolerance (BI). Patients converted to LSG had mean preoperative weight and BMI of 104.9 ± 23.7 kg and 39.2 ± 5.8 kg/m2, respectively. One-year percentage of total weight loss (%TWL) and percentage of excess weight loss (%EWL) were 26.1 ± 9.6 and 76.9 ± 29.7, respectively. One patient (3.3%) developed staple-line leak and needed readmission. After 1 year, primary LSG had better weight loss compared to conversional LSG.

Conclusion:

Most patients with AGB end up with conversion mainly due to WR and BI. Conversion of AGB to other BS is safe and effective at private centers in Saudi Arabia. Weight loss after conversional LSG is inferior to primary LSG.

Introduction:

Since its introduction in the 1980s, the rise and fall of AGB have been evident in the literature. Initially, the expectations were that AGB would be considered a stable option in obesity management, probably due to its reversibility and simplicity. Long term studies demonstrated good outcomes where O’Brien et al. showed a decent %EWL over ten years ranging from 35–60%. Another report by Favretti et al. demonstrated an %EWL of 35% to almost 50% over ten years. Despite that, AGB started to fall behind and was overtaken by other procedures, namely the LSG and RYGB, which led to the increasing rate of AGB removal followed by another BS.

Although the conversion of restrictive BS has been evaluated before, the optimal option for conversion is still debated. The experience with AGB conversion in Saudi Arabia is not well reported in the literature. Sadly, this observation can be generalized to most primary BS, as indicated by the significant
discrepancy between the increasing number of conducted BS compared to the insufficient publications. (7) This study aims to report the experience of AGB conversion at a single private center in Saudi Arabia to evaluate the indication of conversion, the safety of one stage conversion to other BS, and the %TWL and %EWL after one year. Additionally, the rate of weight loss in the same conversion group was compared at two points: nadir weight/BMI after AGB and one-year post-conversion to LSG. Finally, patients converted from AGB to LSG were matched with patients who had undergone primary LSG and were compared from a weight loss standpoint.

**Methods:**

Patients:

This is a retrospective study conducted at a single private clinic in Riyadh Saudi Arabia. Patients subjected to AGB removal with conversion to different bariatric surgeries were included. Demographics, comorbidities, smoking, pre-band, pre-conversion weight/BMI, nadir weight/BMI after AGB, duration of band, indications for conversion, and operative time were collected. Patients aged 18 years and older with BMI above 30 kg/m2 who were operated on from 2017 till 2021 were included in the study. Any 2-staged surgery was excluded from the study. The definition of weight regain was based on previously published work by Voorwidne et al, which is weight regain to a BMI > 35 kg/m2 after successful loss. (8) Insufficient weight loss was determined by percentage of excess weight loss < 50%. (9) Band intolerance was defined as complaints of dysphagia, odynophagia, or choking. Percentage of total weight loss (%TWL) and percentage of excess weight loss (%EWL) following band insertion at nadir and 1-year post conversion were calculated using the following Eq. (10):

$$\text{%TWL} = \frac{(\text{Preoperative BMI} - \text{nadir BMI})}{(\text{preoperative BMI})} \times 100$$

$$\text{%EWL} = \frac{(\text{Preoperative BMI} - \text{nadir BMI})}{(\text{preoperative BMI} - 25)} \times 100$$

To assess the difference in weight loss between primary and conversion LSG, patients who were converted from AGB to LSG were matched with a control patients undergoing primary LSG in 1:2 ratio. Matching was based on age, gender, preoperative BMI, comorbidities, and ASA score from our database. Complications were reported using Clavien Dindo classification (CDC). (11) All procedures were conducted by the same investigator (AA).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Since this is a retrospective study, informed consent acquisition was waived by the Institutional Review Board of Dr Sulaiman Alhabib hospital institution.

Statistics:
Analysis was conducted using Microsoft Excel. In the conversion group, the mean of elements of interest, weight/BMI before AGB and before conversion, and %TWL and %EWL at nadir after AGB and 1-year after conversion were analyzed using t-test, two-tail distribution, and paired data. For the comparison between the primary and conversion LSG, a t-test, two tail distribution, two-sample data method was used.

Preoperative evaluation:

Patients were interviewed in the clinic and asked about relevant information, including comorbidities, medications, allergies, expectations, goals, and enthusiasm for different BS. All patients with AGB underwent band deflation by sterile measures using a needle to completely aspirate the fluids in the reservoir. An upper contrast study and esophagogastrroduodenoscopy (EGD) are performed appropriately. A preoperative investigation including basics laboratory tests, chest x ray, and electrocardiography are completed. A clear consent is taken which states conversion to LSG unless extensive adhesions precludes LSG and an intraoperative decision is made either to postpone the conversion or to convert directly to gastric bypass.

Surgical technique and post-operative management:

All operations were performed by a trained fellow of the Royal College of physicians and surgeons of Canada. After anesthesia induction, the abdomen is accessed through a 5 mm vesiport in the above and to the left of the umbilicus, followed by a 5 mm port at left upper quadrant, a 5 mm port right upper quadrant, Nathanson retractor at epigastric area, a 15-mm port above and to the right of umbilicus. After general inspection, we tend to evaluate the position of the band and the amount of adhesions. All adhesions are released that are commonly found to the liver. From the exterior part of the band that is visible, the gastro-gastric groove is identified and opened circumferentially, until the band is fully released from the stomach. Any remnant capsule or fibrotic tissue is removed while preserving the gastric wall and avoiding injury (Fig. 1). After removing the band, the gastric wall is inspected carefully for any signs of perforation or erosion. The capsule is removed from the area on which we plan to apply the stapler. Careful dissection and separation of the capsule from the stomach wall is paramount if it can be completed without jeopardizing it. Any hiatal hernia discovered is repaired with complete esophageal mobilization until 2–3 cm of intra-abdominal esophagus is achieved. An anterior and posterior nonabsorbable suture repair is our preferable method of hiatal hernia repair followed by assuring smooth transition of bougie through the repair to exclude any tightness. Using an energy device, the greater omentum is released from the greater curvature 4–5 cm from the pylorus, till reaching the gastroesophageal junction. the sleeve is constructed by stapling along the greater curvature using a 36 Fr bougie. We tend to leave 1–2 cm length from the angle of His. The staple line is reinforced with 3 – 0 monofilament sutures, followed by omentopexy. The procedure is completed by removing the reservoir and closing the skin.

In case the adhesions were too extensive, impeding conversion to LSG, conversion to one anastomosis gastric bypass is the usual option, transecting the stomach horizontally below the band area at the incisura, and making sure to keep a long pouch preventing possible bile reflux. Distal to ligament of
Treitz, 150 to 180 cm of jejunum is brought up and a side to side gastrojejunostomy is constructed at 3 cm mark. The common enterotomy is closed using monofilament sutures, followed by application of anti-kink sutures.

One patient had band erosion discovered during the operation as he was asymptomatic preoperatively (Fig. 2). After the band was removed, the stomach wall was unhealthy and showed signs of perforation which was not amenable for repair (Fig. 3). The diseased part was resected and conversion to RYGB by a hand-sewn near esophagojejunostomy was constructed (Fig. 4).

Patients are kept NPO until the next day, where a contrast study is conducted to check for leaks or interrupted flow. If the contrast study is negative, feeding started with clear fluids. The team and the clinical dietician assess patients with written instructions regarding diet intake, medications, and contact number in case of an emergency. Patients are seen two weeks later, then every three months with laboratory tests.

**Results:**

After reviewing the database, from January 2017 until January 2021, 45 patients were found to have AGB converted to another bariatric procedure by the same surgeon. Twelve patients were managed in a 2-stage approach and 3 patients had incomplete data and were excluded from the study. A total of 30 patients including 22 females (73.3%) and 8 males (26.6%) were included in the study. The mean age was 41.2 ± 10.9 years. Mean preoperative weight and BMI before conversion were 107.3 ± 23.2 kg and 39.8 ± 5.7 kg/m² respectively. Five patients had diabetes mellitus (16.6%), 6 patients had hypertension (20%), 10 had dyslipidemia (33.3%), and 9 were smoker (30%). Table 1 shows the indications for AGB conversion, with WR and BI being the most common indication (30%). The mean duration of AGB insertion till conversion was 9.5 ± 4.1 years. Twenty six patients were converted to LSG, and four patients were converted to other BS (3 OAGB, 1 RYGB). The decision for OAGB in 3 patients was because of extensive adhesions that deemed LSG conversion risky. Conversion to RYGB in one patient was due to band erosion and LSG was not applicable.

<table>
<thead>
<tr>
<th>Indications</th>
<th>N = 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>WR only</td>
<td>5 (16.6%)</td>
</tr>
<tr>
<td>WR and BI</td>
<td>9 (30%)</td>
</tr>
<tr>
<td>IWL only</td>
<td>8 (26.6%)</td>
</tr>
<tr>
<td>IWL and BI</td>
<td>8 (26.6%)</td>
</tr>
<tr>
<td>Duration of band (years)</td>
<td>9.5 ± 4.12</td>
</tr>
</tbody>
</table>

WR: weight regain, BI: band intolerance, IWL: insufficient weight loss
Prior to AGB insertion, mean weight/BMI were 106.4 ± 24.7 kg and 39.75 ± 6.8 kg/m², which were not significantly different from the measurements before AGB conversion (P = 0.74, 0.95 respectively). After 1-year from conversion, %TWL was 26 ± 9.2 and %EWL was 74.7 ± 28.6. There were no difference in %TWL (22.3 ± 12.3 vs 26 ± 9.2, P = 0.12) and %EWL (64.7 ± 36.8 vs 74.7 ± 28.6, P = 0.16) between post AGB insertion at nadir and 1 year post conversion (Table 2).

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Pre-AGB insertion and pre-conversion measurements, %TWL, and %EWL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative measurements</td>
</tr>
<tr>
<td>Mean weight (kg)</td>
<td>106.4 ± 23.7</td>
</tr>
<tr>
<td>Mean BMI (kg/m²)</td>
<td>39.7 ± 6.8</td>
</tr>
<tr>
<td>Postoperative outcome</td>
<td>After AGB insertion</td>
</tr>
<tr>
<td>Mean %TWL</td>
<td>22.3 ± 12.3</td>
</tr>
<tr>
<td>Mean %EWL</td>
<td>64.7 ± 36.8</td>
</tr>
</tbody>
</table>

a: at nadir, b: at 1 year, %TWL: percentage total weight loss, %EWL: percentage excess weight loss, AGB: adjustable gastric band

One patient (3.33%) developed a stapleline leak and required readmission within 30-days, managed with endoscopic fully covered stent insertion, total parental nutrition, and IV antibiotics until complete healing, and discharged home (CDC 3a). Two patients (6.66%) developed GERD symptoms controlled by proton pump inhibitors (CDC 2). One patient (3.33%) developed significant GERD after 1-year and was converted to RYGB (CDC 3b).

Patients converted to LSG were matched with controls who had undergone primary LSG. There were no differences in the demographics between the two samples. (Table 3) There were no differences between conversional and primary LSG with regards to mean pre-operative weight (104.9 ± 23.7 vs. 101.9 ± 28.9, P = 0.63) and pre-operative BMI (39.2 ± 5.8 vs. 37.7 ± 4.2, P = 0.38). Operative time was significantly higher in the conversional group (111.3 min vs. 46.9 min, P < 0.00001). After 1-year, %TWL was significantly higher in the primary LSG compared to conversional LSG (26.1 ± 10 vs. 30.9 ± 7.56, P = 0.03). When assessing outcome by the %EWL metric, there was almost a significant difference between primary and conversional LSG (78.7 ± 30.1 vs. 90.8 ± 26.9, P = 0.051).
Table 3
Comparison between Conversional and primary LSG

<table>
<thead>
<tr>
<th></th>
<th>Conversional LSG</th>
<th>Primary LSG</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>26</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>21 (80%)</td>
<td>35 (67%)</td>
<td>0.21</td>
</tr>
<tr>
<td>Age</td>
<td>40 ± 10.6</td>
<td>39.9 ± 10.5</td>
<td>0.97</td>
</tr>
<tr>
<td>Mean weight</td>
<td>104.9 ± 23.7</td>
<td>101.9 ± 28.9</td>
<td>0.63</td>
</tr>
<tr>
<td>Mean BMI</td>
<td>39.2 ± 5.8</td>
<td>37.7 ± 4.2</td>
<td>0.38</td>
</tr>
<tr>
<td>DM</td>
<td>2 (7.7%)</td>
<td>9 (16%)</td>
<td>0.25</td>
</tr>
<tr>
<td>HTN</td>
<td>6 (23%)</td>
<td>8 (15.3%)</td>
<td>0.41</td>
</tr>
<tr>
<td>DLD</td>
<td>7 (26.9%)</td>
<td>9 (17.3%)</td>
<td>0.32</td>
</tr>
<tr>
<td>Smoker</td>
<td>6 (23%)</td>
<td>4 (7.7%)</td>
<td>0.056</td>
</tr>
<tr>
<td>ASA ≥ 3</td>
<td>13 (50%)</td>
<td>28 (53.8%)</td>
<td>0.47</td>
</tr>
<tr>
<td>1 year TWL</td>
<td>26.1 ± 9.6</td>
<td>30.9 ± 7.5</td>
<td>0.03*</td>
</tr>
<tr>
<td>1 year EWL</td>
<td>76.9 ± 29.7</td>
<td>90.8 ± 26.9</td>
<td>0.051</td>
</tr>
<tr>
<td>Operative time</td>
<td>111.3 ± 29.6</td>
<td>46.9 ± 17.8</td>
<td>&lt;0.00001*</td>
</tr>
</tbody>
</table>


Discussion:
The mechanism behind weight loss by purely restrictive procedures seems to be rudimentary and straightforward. Patients will tend to avoid specific types of food and change their eating habits to prevent unpleasant experiences like regurgitation after AGB. (12) Hormonal profile changes caused by BS are considered a strong drive for weight loss its sustainability. Ghrelin, an appetite-stimulating hormone, is markedly reduced following LSG than the elevated levels after AGB, which is unfavorable and probably predisposes to WR/IWL. (13) Tsouristakis et al. assessed the hormonal profile following restrictive procedures. They compared it to the profile following RYGB. The postprandial gut hormone profile after RYGB, mainly GLP-1 and PYY, was significantly elevated, unlike the unchanged profile with AGB. Even though ghrelin level was elevated in both groups, the RYGB group had more sustainable weight loss. (14)

Comparative studies concur with the superiority of RYGB and LSG compared to AGB. In a prospective randomized trial, Nguyen et al. demonstrated better weight loss, resolution of comorbidities, and a lower rate of long-term complications with RYGB compared with AGB. (15) Another large retrospective review of
the Michigan Bariatric Surgery Collaborative data showed more sustainable weight reduction, a higher rate of comorbidities resolution, and better patient satisfaction with RYGB and LSG than AGB. (16) In the sixth global registry report by the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO), the AGB had dropped to the fourth most common BS. Despite these remarks, some patients preferred the AGB over other procedures. One of the reasons behind the attractiveness of AGB was its reversibility and less invasive nature compared to other BS. (17) In our sample, most patients (30%) opted for AGB because it was the only MS available at the time of surgery before the introduction of RYGB or LSG, but also the ability to remove it at any time was appealing.

Patients with AGB suffering from IWL/WR comprise a significant portion seeking a solution. Hence, a subsequent BS is inevitable. If a conversion is not conducted after AGB removal, some patients will gain weight even with positive lifestyle changes and a satisfactory amount of physical activity. (18, 19) Moon et al. found similar weight loss between conversional RYGB (CRYGB) and conversional LSG (CLSG), but the CRYGB patients had a higher rate of comorbidities preoperatively; hence the improvement/resolution of those comorbidities was more impressive in the CRYGB group. (20) Unfortunately, a higher rate of complications (17.5% for CRYGB) than 8.3% for CLSG was observed. A similar finding was reported by Yeung et al. where patients revised to RYGB or LSG because of IWL had equivalent %EWL and resolution of comorbidity rates but higher 30-day morbidity rate (18.8 vs. 12.5, CRYGB vs. CLSG, respectively). (21) Because CRYGB is more demanding from a technical standpoint, it translated to longer operative time and higher blood loss. Angrisani showed similar results between CRYGB and CLSG regarding %EWL, comorbidity resolution, and sustainable weight loss over five years in a more homogenous study sample. However, dumping syndrome and internal hernia occurred with patients subjected to CRYGB. (22) A recent systematic review comparing RYGB and LSG as a conversion option for AGB showed equivalent outcomes in terms of % EWL. (23, 24) There are different conclusions in the literature regarding the best conversion option, but the consensus is that conversion is highly recommended after AGB removal regardless of the BS chosen. (5, 25) When it can be offered safely, we believe that LSG is an excellent choice for conversion after AGB because it is less demanding from a technical standpoint and shows promising results. It also allows us to reserve other options for conversion, i.e., RYGB or OAGB in case WR/IWL occurs after CLSG. An interesting observation from our study that highlights a drawback of AGB is BI comprising more than half of the patients. Although the %TWL and %EWL at a nadir after AGB and at 1-year post-conversion were comparable, indicating AGB effectiveness, it is however for a relatively short time until patients become unsatisfactory with the WR/IWL or the highly prevalent BI develops leading to conversion.

Anastomotic leak is notoriously known as the “Achilles heel” for LSG. The rate of staple-line leak following primary LSG can reach up to 3%. (26, 27) Full mobilization of the fundus is required for proper LSG, which can be slightly harmful if an aggressive dissection is made near the gastroesophageal junction and the angle of His. (28) In addition to other technical factors, since the blood supply at Angle of His is lower compared with other gastric areas, ischemic mechanisms can explain why leaks occur near the gastroesophageal area. (29, 30) Tan et al found a thicker gastric wall and inflammatory changes in addition to decreased vascularity in the area of AGB. With these changes in mind, it is justified to worry...
about a higher leak rate during AGB removal and a concomitant LSG. (31) Hence, we tend to dissect the capsule and the accompanying reactive tissue until reaching the stomach wall to allow perfect stapling. It is our practice to imbricate the staple line with reinforcement suture and gastropexy. Despite that, one of our patients (3.33%) developed a staple line leak, partially due to nonadherence to instructions and withholding crucial history information that might necessitate further workup. Luckily, the patient was managed conservatively with stent placement, intravenous antibiotics, and parental nutrition until the leak was resolved.

The difference in efficacy between primary and conversional bariatric procedures could be attributed to technical factors or psychological causes. (32, 33) In the case of conversion from AGB to LSG, some reports investigated the efficacy of primary vs. conversional LSG. In the short term, weight loss after primary LSG was found to be significantly higher compared to conversional LSG. (34) Contradictory results were also reported, with a comparable rate of weight loss between the primary and conversional LSG. (35) In a relatively large number of patients, Noel et al found that patients with primary LSG had faster weight loss in the first two years compared to those with conversional LSG. This significant observation became trivial after five years of follow-up, with both groups showing similar failure rates. (36) Similarly, Alqahtani et al. found that LSG as the conversion choice poses a potential long-term satisfactory outcome. (37) On the other hand, after six years of follow-up, Carandina et al concluded that LSG as a conversion choice following AGB might not be optimal for all patients, and a more thorough evaluation is recommended. (38) We found that conversion LSG had less %TWL after one year compared to primary LSG (26.1 ± 10 vs. 30.9 ± 7.5, P = 0.03), but when weight loss is reported by %EWL, the significance is almost nullified (78.7 ± 30.1 vs. 90.8 ± 26.9, P = 0.051). The more accurate way of reporting weight loss is debated in the literature, but more data suggest utilizing %TWL as it is more robust and less affected by BMI. (8) Only one aspect is controlled if we assume that LSG is performed according to the standardized technique. Patient compliance and dietary habits play a crucial aspect. Suppose weight loss after a conversion from a restrictive procedure to another restrictive type is dampened; in that case, calorie-dense foods that are easy to eat (sweets and soft drinks) are a significant culprit. (39) Even if LSG’s efficacy and appropriateness after AGB have been questioned, the simplicity of the procedure is an attractive feature. Moreover, it allows for an additional option instead of switching to more technically demanding malabsorptive procedures.

Although our study reports an experience that is not commonly reported in the literature, i.e., private center in Saudi Arabia, our study has limitations starting with the small sample size. Unfortunately, there is no BS database in Saudi Arabia where similar procedures can be pooled, and data can be used to answer questions on a larger scale. Additionally, some of the data were retrospectively gathered from patients, so recall bias might undesirably impact the analysis. Since this study was conducted at a private hospital, adherence to follow-up appointments varied between patients due to financial reasons and unavailability of health insurance to all patients.

Conclusion:
Conversion of AGB to LSG is safe and doable at private centers in Saudi Arabia if it is conducted by a well-trained team. AGB is effective in weight loss but not sustainable for the long term, and hardware intolerance is highly inevitable, requiring removal and conversion to other BS. In the short term, weight loss after conversion BS is inferior compared to primary BS, longer follow-up is needed to confirm this observation.

Declarations:

Conflict of Interest:

The authors declare that they have no conflict of interest.

Ethical Approval:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval for the current study was waived by Ethics committee/IRB of Dr Sulaiman Alhabib hospital institution

Data availability:

The datasets generated and/or analysed during the current study are not publicly available as it will be used for further studies in the futures, but are available from the corresponding author on reasonable request.

References:

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Figures

Figure 1

Dissection of the capsule
Figure 2

Eroded band discovered intraoperatively.
Figure 3

Evidence of air bubbles indicating perforation in a non-healthy gastric wall.
Figure 4

Hand sewn near-esophagojejunostomy.