Background: Revisional bariatric surgeries for weight regain are rising; however, they are considered as riskier and less efficient than primary bariatric procedures. This study aimed to study short-term postoperative outcomes after Roux-en-Y gastric bypass (RYGB) for revision after failed Sleeve gastrectomy versus primary RYGB in Bariatric patients regarding Weight loss, comorbidity resolution, Postoperative complications, hospital stay, mortality, and readmissions.

Patients and Methods: This retrospective study was designed to compare early postoperative outcome between 2 groups of patients admitted to General Surgery Department, Tanta University Hospitals during the period from June 2018 and June 2023.

Results: A total of 254 patients were included in the study, with 87 patients in revisional RYGB and 167 patients in primary RYGB. Groups were matched for age, sex, smoking, preoperative weight, and comorbidities. The duration of revisional RYGB was significantly longer than primary RYGB (201.1±49.85 vs. 161.9±45.05; P < 0.001). Revisional RYGB patients stayed longer in the hospital (2.54±0.74 vs. 1.87±0.78; P < 0.001). Total weight loss was significantly higher after 6 months and 1 year in Primary RYGB than group revisional RYGB (P value<0.05). However, no differences were detected in postoperative complications, readmissions, reoperation rates, and comorbidity resolution.

Conclusion: RYGB as revisional surgery after a previous Sleeve gastrectomy is a complex procedure that must be indicated with care. It is a safe technique, with postoperative complication rates similar to those of primary RYGB, while it may need longer operative time and hospital stay.

Key Words: Bariatric, revision, Roux-en-Y gastric bypass, sleeve, weight loss.

The most common revision procedure after SG was Roux-en-Y gastric bypass (RYGB) (75.2%). Revisional surgery has a high incidence of postoperative complications due to the technical challenges of operating on patients who have already undergone bariatric surgery.

Aim

This retrospective study aimed to study short-term postoperative outcomes after RYGB for Revision after Failed SG versus De novo (primary) RYGB in bariatric patients regarding Weight loss, comorbidity resolution, postoperative complications, hospital stay, mortality, and readmissions.

PATIENTS AND METHODS:

Ethical considerations

(a) Informed consent was obtained before operation from each patient and recorded in patients files, but
regarding this study, which is a retrospective study, no added consent was obtained from patients.

(b) Data were collected anonymously and not used for purposes other than scientific research.

(c) The research ensured complete privacy and confidentiality throughout its duration.

(d) Ethical consideration of the study was carried out according to that of the ethics committee of research at Tanta Faculty of Medicine.

Patient selection

This retrospective study was designed to compare early postoperative outcome between two groups of patients admitted to General Surgery Department, Tanta University Hospitals during the period from June 2018 to June 2023.

Group I Revisional RYGB: patients underwent bariatric surgery in the form RYGB as a revisional operation after failed SG.

Group II Primary RYGB: Patients underwent Bariatric surgery in the RYGB as a primary (de novo) bariatric intervention.

Inclusion criteria

Age between 18 and 65 years old.

(1) Patients who had undergone de novo RYGB operation as a bariatric operation with body mass index more than 35% and completed follow-up for 12 months.

(2) Patients who had undergone RYGB operation as a revisional bariatric operation after SG and presented with

(a) Insufficient weight loss or weight regain (defined as a decrease in the percentage of excess weight loss less than 50% and body mass index more than 35%)

(b) Severe GERD confirmed by endoscopy and pH manometry.

(c) Sleeve stenosis.

Exclusion criteria

(1) Patients who had undergone other bariatric operation other than RYGB (either de novo or after failed SG).

(2) Patients with other major comorbidity (e.g. Cardiac, hepatic or renal).

Study outcomes

1st outcome

The total weight loss (TWL) at 6 and 12 months postoperative, which was calculated using the following formula: \( \% \text{TWL} = \left( \frac{\text{Preoperative weight} - \text{follow-up weight}}{\text{Preoperative weight}} \right) \times 100\% \)

2nd outcomes

(a) Intraoperative and postoperative complications.

(b) Hospital stay.

(c) Comorbidity resolution.

Data recording

Preoperative data

(a) Age.

(b) Sex.

(c) Weight and Body Mass Index (BMI).

(d) Time between SG and RYGB.

(e) History of diabetes mellitus (DM), hypertension (HTN), hyperlipidemia, and obstructed sleep apnea (OSA).

(f) Smoking.

(g) Surgical indication of revision either weight regain, insufficient weight loss, stenosis GERD.

Intraoperative data

(a) Duration of procedure in min.

(b) Blood loss in ml.

Postoperative data

(a) Duration of hospitalization (in days).

(b) Readmission status, together with the identification of the reasons for readmission.

(c) Reoperation.

(d) Postoperative complications such as hematemesis, hemoperitoneum, anastomotic leak, Deep vein thrombosis, pneumonia, atelectasis, and surgical site infection with categorization according to the Clavien–Dindo classification\(^9\).

Methodology

Preoperative workup

Every participant got a comprehensive clinical assessment, standard blood tests, abdominal
ultrasonography, CT Volumetry for revision cases, upper endoscopy, and thromboprophylaxis 12 h preoperative with low molecular weight heparin.

**Surgical technique**

A gastric reservoir of 30–50 ml capacity was formed via an antecolic Roux-en-Y stapled gastrojejunal anastomosis in the antecolic position. The length of the alimentary limb was 150 cm, whereas the biliopancreatic limb measured 100 cm. A stapled jeunojejunostomy was performed with a 45 mm side-to-side anastomosis. A nonabsorbable polypropylene suture was used to close the mesenteric defect. All patients in the revision RYGB group who had previously had SG now received a RYGB procedure comparable to primary RYGB group with meticulous adhesiolysis.

**Postoperative care and follow-up**

Enhanced recovery Following the surgery, preventive measures were taken to prevent postoperative nausea and vomiting, along with pain management, thromboprophylaxis using pneumatic stockings and low-molecular-weight heparin, early mobilization, and initiation of fluid intake the day after the procedure. Patients were discharged upon achieving sufficient oral tolerance.

**Follow-up**

Follow-up was performed 1, 6, and 12 months postoperatively.

**Sample size calculation**

The sample size calculation was done by G*Power 3.1.9.2 (Universitat Kiel, Germany). According to a previous study\(^{[10]}\), the mean±SD of total weight loss (the primary outcome) was 23.8±7.3 kg in primary (de novo) bariatric intervention group and 18.2±6.5 kg in the revisional operation group. The sample size was based on the following considerations: 0.810 effect size, 95% confidence limit, 95% power of the study, group ratio 1:1. Therefore, we will recruit 82 patients at least in our study.

**Statistical analysis**

The statistical analysis was performed using SPSS v27 (IBM, Armonk, NY, USA). The Shapiro–Wilks test and histograms were utilized to assess the normality of the data distribution. The quantitative parametric data were shown as mean and SD and were assessed using an unpaired Student t-test. Qualitative variables were shown as frequency and percentage (%) and assessed using the \(\chi^2\) test or Fisher’s exact test as needed. A two-tailed \(P\) value less than 0.05 was regarded as statistically significant.

**RESULTS:**

**Baseline characteristics**

In total, 254 patients were included in the study, with 87 patients in revisional RYGB and 167 patients in primary RYGB. The baseline characteristics at the time of bariatric surgery are presented in (Table 1).

Age, sex, smoking, preoperative weight, preoperative BMI, height, diabetes, hypertension, sleep apnea, GERD, and hyperlipidemia were insignificantly different between both groups. Regarding surgical indications in group I (Revisional RYGB), weight regains was present in 44 (50.57%) patients, insufficient weight loss was present in 22 (25.29%) patients, GERD was present in 10 (11.49%) patients, GERD with weight regain was present in seven (8.05%) patients and stenosis was present in four (4.6%) patients in revisional RYGB group. Weight regain and insufficient weight loss in revisional group were justified by the increase in sweet consumption and portion size in 60% of patients, large remnant pouch size in 30% of patients detected by CT volumetry, and 10% of patients due to emotional eating.

**Intra and postoperative outcomes**

The duration of revisional RYGB was significantly longer than primary RYGB (201.1±49.85 vs. 161.9±45.05; \(P <0.001\)). Revisional RYGB patients stayed longer in the hospital (2.54±0.74 vs. 1.87±0.78; \(P <0.001\)). Regarding readmissions and reoperation, no significant variations were detected (Table 2).

Hematemesis, hemoperitoneum, anastomotic leak, atelectasis, pneumonia, surgical-site infection, oral intolerance, wound hematoma/seroma, intraabdominal abscess, DVT, mortality, Clavien–Dindo < IIIa, >IIIa and total complication were insignificantly different between both groups (Table 3).

**Follow-up outcomes**

BMI was significantly lower after 6 months and 1 year in Primary RYGB than group Revisional RYGB (\(P\) value=0.046 and 0.001, respectively). TWL was significantly higher after 6 months and 1 year in Primary RYGB than group Revisional RYGB (\(P\) value<0.05). (Figs 1 and 2) Readmission, reoperation, diabetes, hypertension, sleep apnea, GERD and hyperlipidemia resolution were insignificantly different between both groups (Table 4).
Table 1: Patients baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Revisional RYGB (N=87) [n (%)]</th>
<th>Primary RYGB (N=167) [n (%)]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>40.13±6.01</td>
<td>39.59±7.22</td>
<td>0.551</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (11.49)</td>
<td>26 (15.57)</td>
<td>0.377</td>
</tr>
<tr>
<td>Female</td>
<td>77 (88.51%)</td>
<td>141 (84.43)</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>5 (5.75)</td>
<td>3 (1.8)</td>
<td>0.125</td>
</tr>
<tr>
<td>Surgical indications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight regains</td>
<td>44 (50.57)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Insufficient weight loss</td>
<td>22 (25.29)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>GERD</td>
<td>10 (11.49)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>GERD + Weight Regain</td>
<td>7 (8.05)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Stenosis</td>
<td>4 (4.6)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Preoperative weight (kg)</td>
<td>127.33±7.47 (111–140)</td>
<td>129.39±8.36 (120–173)</td>
<td>0.055</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>161.48±5.79 (152–172)</td>
<td>161.34±5.49 (154–171)</td>
<td>0.846</td>
</tr>
<tr>
<td>Preoperative BMI (kg/m²)</td>
<td>48.99±4.23 (46–52)</td>
<td>49.86±4.86 (45–54)</td>
<td>0.155</td>
</tr>
<tr>
<td>Time between two operations (years)</td>
<td>2.11±0.43</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Diabetes</td>
<td>21 (24.14)</td>
<td>39 (23.35)</td>
<td>0.889</td>
</tr>
<tr>
<td>Hypertension</td>
<td>53 (60.92)</td>
<td>97 (58.08)</td>
<td>0.663</td>
</tr>
<tr>
<td>Sleep apnea</td>
<td>36 (41.38)</td>
<td>67 (40.12)</td>
<td>0.846</td>
</tr>
<tr>
<td>GERD</td>
<td>17 (19.54%)</td>
<td>40 (23.95)</td>
<td>0.424</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>29 (33.33)</td>
<td>47 (28.14)</td>
<td>0.391</td>
</tr>
</tbody>
</table>

*: significant as P value less than or equal to 0.05. Data are presented as mean±SD or frequency (%). BMI: body mass index.

Table 2: Readmission, reoperation, and hospital stay of the studied groups

<table>
<thead>
<tr>
<th></th>
<th>Revisional RYGB (N=87) [n (%)]</th>
<th>Primary RYGB (N=167) [n (%)]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>201.1±49.8 (120–280)</td>
<td>161.9±45.05 (90–230)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>2.54±0.74 (2–5)</td>
<td>1.87±0.78 (1–3)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Readmission 30 days</td>
<td>6 (6.9)</td>
<td>11 (6.59)</td>
<td>0.925</td>
</tr>
<tr>
<td>Reoperation 30 days</td>
<td>2 (2.3)</td>
<td>3 (1.8)</td>
<td>1</td>
</tr>
</tbody>
</table>

*: significant as P value less than or equal to 0.05. Data are presented as mean±SD or frequency (%).

Table 3: Complication of the studied groups

<table>
<thead>
<tr>
<th>Complication</th>
<th>Revisional RYGB (n=87)</th>
<th>Primary RYGB (n=167)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematemesis</td>
<td>2 (2.3)</td>
<td>5 (2.99)</td>
<td>1</td>
</tr>
<tr>
<td>Hemoperitoneum</td>
<td>1 (1.15)</td>
<td>4 (2.4)</td>
<td>0.663</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>2 (2.3)</td>
<td>3 (1.8)</td>
<td>1</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>3 (3.45)</td>
<td>5 (2.99)</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1 (1.15)</td>
<td>3 (1.8)</td>
<td>1</td>
</tr>
<tr>
<td>Surgical-site infection</td>
<td>4 (4.6)</td>
<td>7 (4.19)</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4: Total weight loss, readmissions, reoperation, and comorbidities resolution of the studied groups

<table>
<thead>
<tr>
<th></th>
<th>Revisional RYGB (N=87) [n (%)]</th>
<th>Primary RYGB (N=167) [n (%)]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>34.05±5.03</td>
<td>32.74±4.9</td>
<td>0.046*</td>
</tr>
<tr>
<td>After 1 year</td>
<td>32.27±5.24</td>
<td>29.66±6.37</td>
<td>0.001*</td>
</tr>
<tr>
<td><strong>TWL</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>After 6 months</td>
<td>19.61±2.83</td>
<td>27.52±3.38</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>After 1 year</td>
<td>24.59±2.29</td>
<td>32.11±2.27</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td><strong>Readmission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>3 (3)</td>
<td>6 (4)</td>
<td>1</td>
</tr>
<tr>
<td>After 1 year</td>
<td>2 (2)</td>
<td>3 (2)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Reoperation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>After 1 year</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td><strong>Diabetes resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>6 (28.57)</td>
<td>19 (48.72)</td>
<td>0.131</td>
</tr>
<tr>
<td>After 1 year</td>
<td>13 (61.9)</td>
<td>25 (64.1)</td>
<td>0.866</td>
</tr>
<tr>
<td><strong>Hypertension resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>30 (56.6)</td>
<td>65 (67.01)</td>
<td>0.206</td>
</tr>
<tr>
<td>After 1 year</td>
<td>35 (66.04)</td>
<td>78 (80.41)</td>
<td>0.051</td>
</tr>
<tr>
<td><strong>Sleep apnea resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>14 (38.89)</td>
<td>20 (29.85)</td>
<td>0.352</td>
</tr>
<tr>
<td>After 1 year</td>
<td>19 (52.78)</td>
<td>38 (56.72)</td>
<td>0.701</td>
</tr>
<tr>
<td><strong>GERD resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>5 (29.41)</td>
<td>8 (20)</td>
<td>0.768</td>
</tr>
<tr>
<td>After 1 year</td>
<td>9 (52.94)</td>
<td>16 (40)</td>
<td>0.368</td>
</tr>
<tr>
<td><strong>Hyperlipidaemia resolution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 6 months</td>
<td>10 (34.48)</td>
<td>18 (38.3)</td>
<td>0.738</td>
</tr>
<tr>
<td>After 1 year</td>
<td>15 (51.72)</td>
<td>28 (59.57)</td>
<td>0.502</td>
</tr>
</tbody>
</table>

*: significant as P value less than or equal to 0.05. Data are presented as mean±SD or frequency (%).

BMI, body mass index; TWL, total weight loss.
Fig. 1: BMI changes of the studied group.

Fig. 2: Total weight loss of studied patient.
DISCUSSION

Our study showed that the revisional RYGB group had significantly longer operative time and hospital stay compared with the primary RYGB group. Additionally patients in Primary RYGB group experienced significantly better weight loss throughout the 1 year follow-up than the revisional RYGB group. On the other hand no significant differences were detected in readmission, reoperation, postoperative complications, and comorbidity resolution at 6 months and 1 years follow-up.

Baseline characteristics regarding preoperative weight and comorbidities were statistically insignificant and this helped us in accurate comparison between the both groups and this was comparative with results of Chowbey et al.[10], Vallois et al.[13], and Mor A et al.[11]. On contrary previous studies have significant difference in baseline characteristics with older patients with lower preoperative BMI in revisional group[14–16] and this represented a selection bias for their studies.

In our study, the most frequent indications of revision were weight regain (50.57%), insufficient weight loss (25.29%), GERD (11.49%), GERD with weight regain (8.05%) and stenosis (4.6%) which was in agreement with Lazzati et al.[7], Chowbey et al.[11] and Campo-Betancourt et al.[18] who showed weight regain (47.9%), insufficient weight loss (25%), weight regain/insufficient weight loss plus GERD (14.6%), and GERD (12.5%).

Our findings aligned with previous studies demonstrating a significantly lower weight loss in Revisional RYGB patients as Giannopoulos et al.[10], Vallois et al.[13], Mor et al.[13], Axer et al.[14] and Delko et al.[17] and this was justified as the revisional surgeries may need more aggressive procedures to achieve more weight loss. Biliopancreatic diversion with duodenal switch (BPD-DS) and single anastomosis duodenal-ileal bypass (SADI) restate the most appropriate second procedure regarding weight loss however they carry an increased risk of deficiencies, protein malnutrition, and intestinal bacterial overgrowth as denoted by Li et al.[18].

Furthermore, we showed that Revisional RYGB group was represented by statistically significant longer operative time (P<0.001) which is likely due to extensive adhesions and distorted anatomy related to the previous sleeve surgery. Our results align with Giannopoulos et al.[10] (203 vs. 153), Chowbey et al.[11] (151 vs. 137), Delko et al.[17] and with Zhang et al.[19] (272.5 vs. 175.5). Nonetheless some studies failed to detect any difference in operative time as Vallios A et al.[12] and Campo-Betancourt et al.[18].

Regarding the length of hospital stay, revisional RYGB group showed significantly longer hospital stay P less than 0.001 and this is justified by the delay in starting oral intake with the longer period the patient can tolerate oral intake and also the longer period to deal with the postoperative nonsurgical complications. Our results were consistent with Vallois et al.[13], Mor et al.[13], Zhang et al.[19], and Dardamanis et al.[20], but did not align with Giannopoulos et al.[10] and Chowbey et al.[11] which showed the insignificant difference between both primary and revisional groups. Also, our results were inconsistent with Campo-Betancourth et al.[18] which showed significantly shorter hospital stays in the revision group justified by the fact that revision surgery in their center has been performed mainly since 2016, coinciding with the implementation of the Enhanced Recovery After Surgery protocols in recent years.

When analyzing comorbidity resolution in both groups, we could not detect any significant differences. Our results were comparable with the Chowbey et al.[11], Vallois et al.[13], and Pędziwiatr et al.[21].

Overall, there was no significant difference in the total complications between the revisional and primary RYGB groups P=0.558 these results were aligned with the results of Campo-Betancourth et al.[15] P=0.597, Vallois et al.[13] P=0.25, Chowbey et al.[11] and the rate obtained with RYGB in Gero et al.[22] However, some studies suggest that morbidity after revisional bariatric surgery greater than those of primary RYGB. Zhang et al.[19] showed that more patients in the laparoscopic revisional RYGB had overall complications than primary RYGB patients (38 vs. 19 patients, P=0.002). Zingg et al.[23] showed that medical morbidity was significantly higher in revisional procedures (9.8% vs. 0%, P=0.031). Also Hallowell et al.[24] showed that leaks occurred more frequently following revisional surgeries (11% vs. 1.2%) P<0.0006 but revisional surgery was done by the open approach. El Chaar et al. showed that the rate of complications necessitating reoperation or intervention within 30 days after revision RYGB was double that of primary RYGB (3.9% and 4% for Revision bariatric surgery versus 2.4 and 2.7% for primary bariatric surgery, respectively, P<0.05)[23].

CONCLUSION

RYGB as a revisional procedure following a SG is a complex surgery that should be indicated with care. The method is safe, with postoperative complication rates comparable to those of primary RYGB, while it may need longer operative time and hospital stay. More systematic studies may be needed to compare the efficacy of RYGB as a revisional surgery after sleeve
with other more complex procedures if the target was to achieve lower BMI.

**LIMITATIONS**

Our results were retrospective and in a single institution. Also, another limitation was that we didn’t exclude the patients undergoing redo for sleeve complications as stenosis and GERD.

**CONFLICT OF INTEREST**

There are no conflicts of interest.

**REFERENCES**


