

# Management of post-bariatric complications.

## Our Center experience and literature review



Ann Ital Chir, 2021 92, 6: 636-644

pii: S0003469X2103606X

Online ahead of print 2021 - Oct. 21

free reading: www.annitalchir.com

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### Management of post-bariatric complications: our Center experience and literature review

*Bariatric surgery is recognized as the most effective treatment for morbid obesity, maintaining a stable weight reduction in the long term and reducing comorbidities, with a favorable impact on mortality. The aim of this study is to evaluate the complication rate and treatment techniques adopted in all patients undergoing bariatric surgery procedures in our center.*

*From May 2017 to March 2020, 91 patients with morbid obesity are admitted to the Department of Medical and Surgical Science of the University Hospital of Foggia undergoing bariatric surgery.*

*Seventyone patients underwent sleeve gastrectomy, nineteen gastric bypass and one mini-gastric bypass, five of these were redo operation procedures.*

*Regarding postoperative complications (8,8%), there were 1 gastric leak (1,09%), 4 bleedings (4,39%) - 1 intraluminal bleeding and 3 intra-abdominal bleedings, 2 port-sites infections (2,19%) and 1 haemoperitoneum (1,09%). In our center we have also treated 3 cases of complications after bariatric surgery procedures performed in others centers.*

*There were no deaths.*

*Despite improvement in the performance of bariatric surgical procedures, complications are not uncommon. Flexible endoscopy has become an essential tool in managing bariatric surgery patients and offers the benefit of providing both diagnostic and therapeutic applications.*

**KEY WORDS:** Bariatric surgery, Bleeding post-bariatric surgery, Complications bariatric surgery, Gastric bypass, Leak post-sleeve gastrectomy, Mini invasive approach, Sleeve gastrectomy

### Introduction

Obesity is one of the most critical risk factors of several lifethreatening diseases. There are more than 1 billion overweight adults and at least 300 million obese, meaning that their body mass index (BMI) exceeds 30 kg/m<sup>2</sup> <sup>1</sup>. The prevalence of obesity in adults has dramatically increased over the past ten years <sup>2</sup>. Researchers have

demonstrated that obese people in the identified classes (I, II, or III) are at the higher risk of obesity-related diseases, co-morbid conditions, lower quality of life (QOL), and increased mortality more than those in the normal range of BMI (18.5-24.9) <sup>3,4</sup>. Although, having a healthy lifestyle, seems to be an ideal option to lose weight, surgical treatment continues to be the most efficient and scientifically successful method for those with excessive amount of adipose tissue (class II or III). The gastric bypass, sleeve gastrectomy, adjustable gastric band, and biliopancreatic diversion with the duodenal switch are the most popular and common bariatric surgery (BS) procedures <sup>5,6</sup>.

Bariatric surgery is recognized as the most effective treatment for morbid obesity, maintaining a stable weight

*Pervenuto in Redazione Marzo 2021. Accettato per la pubblicazione Aprile 2021.*

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reduction in the long term and reducing comorbidities, with a favorable impact on mortality<sup>7-9</sup>.

Among the different types of bariatric procedures, sleeve gastrectomy (SG) is today one of the most performed worldwide<sup>10,11</sup>. Due to its technical feasibility, it was quickly adopted by all the bariatric surgical groups. Different studies have demonstrated its safety and effectiveness.

Bleeding, leakage, and gastric fistulae are the most common intraoperative complications and post-operative complications after bariatric procedures<sup>12-14</sup>.

Literature reports a wide range of post-bariatric surgery complications, from 1% to 29%. Most common post-operative complications reported include leakage, hemorrhage, fistula, surgical site infection, abscess, gastric dilatation, stricture, wound complication, and nutritional deficiencies<sup>15-16</sup>.

The aim of this study is to relate the literature data to the complication rate and treatment techniques adopted in all patients undergoing bariatric surgery procedures at the Department of Medical and Surgical Sciences of the University Hospital of Foggia from May 2017 to March 2020.

## Materials and Methods

From May 2017 to March 2020, 91 patients with morbid obesity are admitted to the Department of Medical and Surgical Science of the University Hospital of Foggia undergoing bariatric surgery. Inclusion criteria are: age  $\geq 18$  years, BMI of  $\geq 35-39$  kg/m<sup>2</sup> with one obesity-associated co-morbidity or BMI  $\geq 40$  kg/m<sup>2</sup>. Before surgery, patients completed a standardized psychological and physical assessment which includes blood chemistry tests, chest x-ray, electrocardiogram, nutritional examination, cardiological examination, spirometry, esophagus-gastro-duodenoscopy, psychiatric examination.

We analyzed operative and postoperative minor and major complications; length of hospital days, preoperative BMI, incidence of reinterventions and operative time.

## Results

We analyzed 91 patients underwent bariatric surgery procedures in our Center with a mean age of  $42,7 \pm 9,86$  years, a mean BMI of  $45,39 \pm 5,46$ , sixtytwo patients were female. Seventy-one patients underwent sleeve gastrectomy, nineteen gastric bypass and one mini-gastric bypass, five of these were redo operation procedures: 2 gastric bypass after failure of sleeve gastrectomy, 2 sleeve gastrectomy after failure of gastric banding and 1 mini-gastric bypass after sleeve gastrectomy.

The mean operative time was  $120,67 \pm 40,66$  minutes ( $94,68$  min for laparoscopic sleeve gastrectomy and

$116,05$  min for gastric bypass), the median length of stay was  $4,5 \pm 7,4$  days.

Two patients required conversion to open surgery, 1 gastric bypass and 1 mini-gastric bypass.

Regarding postoperative complications (8,8%), there were 1 gastric leak (1,09%), 4 bleedings (4,39%) - 1 intraluminal bleeding and 3 intra-abdominal bleedings, 2 port-sites infections (2,19%) and 1 haemoperitoneum (1,09%). In our center we have also treated 3 cases of complications after bariatric surgery procedures performed in others centers.

There were no deaths. Follow-up at 1 month from the recovery in 91 patients has showed an EWL (excess weight loss) 20,29%, at 6 months 46,8%, at 12 months 52,41%.

## Discussion

Peri-procedural complications have been reduced by the development and wide spread use of laparoscopic techniques, improved training and credentialing, and establishment of comprehensive and dedicated bariatric surgery programs<sup>17-19</sup>. Nevertheless, bariatric surgery related complications remain a clinical challenge. Traditional management of these complications has been performed using surgical and interventional radiology techniques. Recently, however, endoscopic therapies have been introduced as an alternative and minimally invasive approach to peri-procedural complications<sup>20</sup>.

The aim of this study is to evaluate the complication rate and treatment techniques adopted in all patients undergoing bariatric surgery procedures in our center. From May 2017 to March 2020, 91 patients with morbid obesity are admitted to the Department of Medical and Surgical Science of the University Hospital of Foggia undergoing bariatric surgery (Table I).

### GASTRIC FISTULA

We reported 1 case of a gastric fistula (1,09%) after robotic sleeve gastrectomy<sup>21</sup>, with an operative time of 130 minutes, treated with the placement of PIG TAIL with endoscopic technique and abdominal drainage with laparoscopic approach.

Anastomotic leaks following bariatric surgery are most commonly found along staple lines. Patients who undergo Roux en-Y Gastric Bypass are most susceptible to anastomotic leak at the Gastro-Jejunal anastomosis due to the single blood supply to the gastric pouch. Leak after Sleeve Gastrectomy is often at the Esophageal-Gastric junction and may be secondary to stenosis at the incisura.

While the cause remains unclear, leaks are hypothesized to be due to technical factors including anastomotic tension, tissue ischemia, size of staple line, tissue thickness,

TABLE I - *Complication data and treatment.*

Type of complication	Age	BMI	Bariatric procedure	Center	Treatment of complication	Mortality
Gastric leak	37 y	47 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	Endoscopic pig tail and abdominal drainage	No
	42 y	43 kg/m <sup>2</sup>	Sleeve gastrectomy	Other center	Abdominal drainage	No
	40 y	44 kg/m <sup>2</sup>	Sleeve gastrectomy	Other center	Abdominal drainage – splenectomy – endoscopic prosthesis	No
	43 y	40 kg/m <sup>2</sup>	Sleeve gastrectomy	Other center	Abdominal drainage – thoraci drainage – exclusion of leak with stapler – esophagostomy	Yes
Endoluminal bleeding	50 y	50 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	medical therapy	No
	32 y	41 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	medical therapy	No
Intrabdominal bleeding	45 y	49 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	medical therapy	No
	37 y	44 kg/m <sup>2</sup>	Roux en-Y gastric bypass	Our center	medical therapy	No
Port-sites	47 y	46 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	advanced dressings	No
Infection	48 y	52 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	advanced dressings	No
Hemoperitoneum	45 y	50 kg/m <sup>2</sup>	Sleeve gastrectomy	Our center	splenectomy	No

and blood supply. Although rare, leaks are associated with significant morbidity and mortality. Overall incidence of anastomotic leak following bariatric surgery is reported to range from 1% to 6%. Specifically, Roux en-Y Gastric Bypass is associated with an incidence of 0.1% to 5.6% while Sleeve Gastrectomy is approximately 2.4%<sup>22,23</sup>.

In the early post-operative period, extra-luminal leaks may lead to a wide array of sequelae including abscess formation, peritonitis, sepsis, multi-organ failure, and death. Clinical signs of a leak, such as tachycardia, abdominal pain, or fever warrant prompt evaluation by the surgeon in order to minimize associated morbidity<sup>24</sup>.

The principles of managing these patients include infection control, nutritional support, and the appropriate therapeutic intervention. We recommend the use of non-surgical, endoscopic interventions for patients without hemodynamic instability in order to minimize the additional stress and risk of iatrogenic injury associated with reoperation. On the other hand, we recommend surgical re-exploration for all critically ill patients and for those patients who do not improve with endoscopic interventions. The types of endoscopic interventions for post-operative anastomotic leaks will be further discussed below<sup>25</sup>.

Hughes et al.<sup>26,27-52</sup> (Table II) elaborated a systematic review showing significant variation in clinical practice with respect to intraoperative surgical technique and the management of a leak from the staple line after a sleeve gastrectomy.

In this systematic review only 5 articles specifically discussed the reasoning for stent placement. Of which, 2 articles stated that the stent was used to occlude the

puncture site. The remaining 3 articles described that the stent extended along the gastroesophageal junction. An important preoperative surgical decision is to select the correct sized bougie to use. Within this systematic review, a 36 Fr (27%) bougie was used most frequently. This finding is consistent with the recommendations of the International Sleeve Gastrectomy Expert Panel Consensus Statement, which advocated the use of a bougie ranging in size from 32 to 36 Fr since the use of a smaller (<32 Fr) bougie is associated a higher complication rates<sup>53</sup>. In our center we use a 40 Fr bugie.

Endoscopic stent placement was the most common endoscopic intervention described in this systematic review. However, it is important to establish that stent placement would not sufficiently manage any concurrent of pre-existing intra-abdominal collections. In this systematic review, a total of 21 patients underwent percutaneous drainage of intra-abdominal collections and placement of endoscopic stent, resulting in an 86% successful treatment rate.

None of the articles that described endoscopic management of the leak utilized endoscopic double pigtail stent insertion. This newly described intervention is gaining popularity as a treatment strategy for staple line leak following sleeve gastrectomy and is likely to serve as one of the main interventions for staple line leak management in the future. Endoscopic drainage via pigtail drain placement as a treatment modality possesses several theoretical advantages as a management strategy for staple line leak following bariatric surgery when compared to percutaneous drainage. Whilst percutaneous drainage of an intra-abdominal collection would facilitate sepsis control, it unfortunately dictates that the patient must have

TABLE II - Review of literature.

Reference	N° of leak	Cohort size	Leak rate of cohort	Size bugie	Staple size used	Intraoperative leak test	Placement of surgical drain
Moloney [27]	6	183	3,3 %	40 Fr	60 mm	No	No
Spicka [28]	3	223	1,3 %	*	*	*	*
Rawlins [29]	1	55	1,9 %	26,4 F endoscope	60 mm	Air insufflation test	Yes
Albanopoulos [30]	12	353	3,4 %	38 Fr	60 mm	No	Yes in 201 cases
Keren [31]	26	26	100 %	*	*	*	*
Casella [32]	6	200	3 %	48 Fr	60 mm	Methylene blu	No
El-Sayes [33]	27	49	55 %	42 Fr	*	Methylene blu	No
Leeds [34]	9	35	26 %	*	*	*	*
Abd Ellatif [35]	11	1395	0,79 %	36-44 Fr	*	Methylene blu	Yes in 319 cases
Gibson [36]	1	500	0,2 %	32 Fr	60 mm	*	*
Hoogerboord [37]	1	166	0,6 %	42 Fr	60 mm	No	No
Szewezyk [38]	8	565	1,42 %	34 Fr	60 mm	Methylene blu	Yes
Curro [39]	1	200	0,5 %	36 Fr	*	Methylene blu	Yes in 50 %
Wahby [40]	10	712	1,4 %	32-38 Fr	*	Methylene blu	No
Rossetti [41]	1	145	0,7 %	36 Fr	*	Air insufflation test	No
Sethi [42]	15	1550	1 %	28-40 Fr	*	Yes	No
Montuori [43]	6	418	1,4 %	36 Fr	60 mm	Methylene blu	Yes
Klizezak [44]	13	13	100 %	*	*	*	*
Southwell [45]	21	21	100 %	*	*	*	*
Behrens [46]	1	34	3 %	36 Fr	*	No	No
Weiner [47]	12	686	1,7 %	42 Fr	*	Methylene blu	Yes
Hany [48]	8	920	0,9 %	36 Fr	60 mm	No	Not routinely
Nocca [49]	6	163	3,7 %	36 Fr	*	Methylene blu	Yes
Skrekas [50]	4	93	4 %	36 Fr	60 mm	Methylene blu	Yes
Csendes [51]	16	343	4,6 %	38 Fr	*	Methylene blu	Yes in 98 %
Dapri [52]	4	75	5 %	34 Fr	*	Air insufflation	Yes

\*Data not specifically available for patients with sleeve gastrectomy leaks

external drainage. The presence of an external drain is not without its associated complications; high drain output may lead to fluid losses, and subsequent electrolyte imbalances, corrosive drain content and frequent contact with skin may result in recurrent skin infection and the patient is of risk of developing an external fistula<sup>54,55</sup>. The presence of an external drain may adversely impact on the patients' quality of life, where as endoscopic drainage would overcome these limitations via establishing internal drainage<sup>56</sup>. In addition, it takes advantage of normal gastrointestinal tract physiology (peristaltic wave induced pressure gradient) to promote fluid drainage into the gastrointestinal tract lumen. From the patients' perspective, it is reported as being better tolerated when in comparison to conventional self-expanding metal stents<sup>57</sup>. A cost-effective analysis of stent usage in the management of sleeve gastrectomy leaks published in 2018 concluded that double pigtail stent was more cost effective than a covered stent; this will clearly have significant financial implications in the context of a symptomatic sleeve gastrectomy leak which is normally associated with a prolonged hospital stay<sup>58</sup>. For all these reasons we preferred to treat our leak after sleeve gastrectomy with placement of pigtail with endoscopic approach, obtaining the complete resolution of the complication. Within this systematic review, a conservative manage-

ment approach had the highest successful initial management rate of 82%. The presence of intra-abdominal collections will influence the need for drainage.

#### BLEEDING

We observed 4 bleedings (4,39%) - 1 intraluminal bleeding after sleeve gastrectomy and 3 intra-abdominal bleedings, 2 after sleeve gastrectomy and 1 after gastric bypass, diagnosed early thanks to the permanence of the nasogastric tube and drainage, treated with medical therapy. Gastrointestinal (GI) bleeding usually presents in the immediate post-operative period secondary to technical complications. Most commonly, this occurs as intraluminal bleeding, but extra-luminal bleeding can occur. Bleeding primarily occurs from the submucosal vessels along the staple line at the gastro-jejuno-stomy, jejuno-jejuno-stomy, or along the staple lines of the gastric pouch. Signs and symptoms of bleeding, including a drop in hemoglobin levels, hematemesis, hematochezia, or melena, should be considered an indication to undergo further evaluation. Endoscopy is often used as a firstline modality for investigation of the source of bleeding<sup>59</sup>. However, when post-operative bleeding is severe and associated with hemodynamic instability, surgical reexploration may be required<sup>60</sup>.



In the immediate 48 h after Roux en-Y Gastric Bypass, hemorrhage is reported to occur with an incidence between 1%-4%. Thirty to sixty-three percent of these occurrences require blood transfusion but are nonetheless self-limited<sup>61-63</sup>. Endoscopy is considered in the early period when patients have proven bleeding and this is refractory to supportive therapy.

Regarding complications post-bariatric surgery in our center, we reported a case of a patient underwent sleeve gastrectomy and discharged on fifth postoperative day, presented on the eighth post-operative day: hypotension, tachycardia, fever and pain in the left hypochondrium, with evidence of hemoperitoneum due to spleen laceration at the abdominal computer tomography (CT) scan and was performed splenectomy.

#### PORT-SITE INFECTION

In our study there were two cases of port-site infection (2,19%) with an incidence of 2% successfully treated by advanced dressings.

Among the various risk factors for the development of port-site infection, obesity deserves special attention due to its increasing incidence in the world<sup>64</sup>.

Thus, it is plausible to infer that surgical procedures performed primarily in obese patients, such as bariatric surgery, should be related to high port-site infection rates<sup>65,66</sup>. Data on the incidence of port-site infection after bariatric surgery vary from 1% to 21.7%, depending on the surgical access performed (laparoscopy or laparotomy)<sup>67,68</sup>.

We reported also, 3 cases of gastric leaks after sleeve gastrectomy performed in other centers and treated in our department:

– A 42-years-old man with radiological evidence of gastric fistula after sleeve gastrectomy, presented leukocytosis, fever and pain in the left hypochondrium, treated with the placement of a drainage with laparoscopic approach.



Fig. 1: Self-expanding covered prosthesis.

– A 40-years-old woman presented in our department as emergency with leukocytosis, fever, pain in the left hypochondrium and epigastrium, increase of protein C reactive (PCR) and Procalcitonin, evidence of gastric fistula at CT scan.

The patient was first treated with a conservative approach, fasting for about 20 days with improvement of the clinical picture, resolution of the radiological picture and discharge after about a month. Subsequently, after 4 months, she presented the same symptoms with reappearance of gastric fistula at CT scan and evidence of intrasplenic abscess (Fig. 2); laparotomy with splenectomy and placement of an abdominal drainage was then performed. At a later time, a self-expanding covered prosthesis (Fig. 1) was placed with endoscopic technique to exclude the fistula replaced three times each one after three weeks.

A 43-years-old with a diagnosis of gastric fistula and mediastinitis, treated with the placement of two abdominal drainages with laparoscopic approach and two thoracic drainages for the resolution of the pleural effusion. Despite this, the fistula replenished in the chest causing a serious septic shock; we performed a laparotomy with the aim of excluding the fistula, therefore the esophagus upstream of the leak was sectioned with a mechanical stapler and performed an esophagostomy on a rod. However, the patient died on the fifteenth post-operative day, due to the persistence of the severe septic state. In this study we have seen that the complication rate and treatment techniques adopted in all patients undergoing bariatric surgery procedures are in line with the literature data.



Fig. 2: Gastric fistula and evidence of intrasplenic abscess.



Fig. 3: Gastric fistula in endoscopic view.



Fig. 4: Positioned self-expanding covered prosthesis.

## Conclusion

Obesity is one of the most significant health problems worldwide. Despite improvement in the performance of bariatric surgical procedures, complications are not uncommon. It is our responsibility to be familiar with these procedures and complication management strategies. According to the literature, our collecting data shown that flexible endoscopy has become an essential tool in managing bariatric surgery patients and offers the benefit of providing both diagnostic and therapeutic applications, therefore, bariatric surgery centers should have an advanced operative endoscopy department.

## Riassunto

L'obesità è una condizione patologica sempre più diffusa. La chirurgia bariatrica è riconosciuta come il trattamento più efficace e duraturo per la cura dell'obesità patologica, garantendo il mantenimento di una riduzione stabile del peso a lungo termine e il miglioramento delle comorbidità, con un impatto favorevole sulla mortalità. Lo scopo di questo studio è valutare il tasso di complicanze e le tecniche di trattamento adottate in tutti i pazienti sottoposti a procedure di chirurgia bariatrica nel nostro centro.

Da maggio 2017 a marzo 2020, 91 pazienti affetti da obesità patologica sono stati ricoverati presso il reparto di Chirurgia Generale Universitaria del Policlinico Riuniti di Foggia per essere sottoposti ad intervento di chirurgia bariatrica. Settantuno pazienti sono stati sottoposti a sleeve gastrectomy, diciannove a bypass gastrico e uno a mini-bypass gastrico, cinque di questi erano interventi di redo surgery. Il tempo operatorio medio calcolato è di  $120,67 \pm 40,66$  minuti (94,68 minuti per la sleeve gastrectomy laparoscopica e 116,05 minuti per il bypass gastrico), la durata media di degenza è di  $4,5 \pm 7,4$  giorni. Per due pazienti si è resa necessaria la conversione a chirurgia a cielo aperto, 1 bypass gastrico e 1 mini-bypass gastrico. Le complicanze postoperatorie (8,8%) che si sono verificate sono state: 1 fistola gastrica (1,09%), 4 sanguinamenti (4,39%) - 1 sanguinamento

intraluminale e 3 sanguinamenti intra-addominali, 2 infezioni dei port-site (2,19 %) e 1 emoperitoneo (1,09%). Nel nostro centro abbiamo trattato anche 3 casi di complicanze successive ad interventi di chirurgia bariatrica eseguiti in altri centri. Il tasso di mortalità è dello 0 %. Il follow-up a 1 mese dall'intervento in 91 pazienti ha mostrato un EWL (perdita di peso in eccesso) del 20,29%, a 6 mesi del 46,8%, a 12 mesi del 52,41%. Si può concludere dicendo che nonostante la crescita ed il miglioramento delle prestazioni delle procedure di chirurgia bariatrica, le complicanze non sono rare. L'endoscopia è diventata uno strumento essenziale nella gestione delle complicanze dei pazienti sottoposti a chirurgia bariatrica e offre il vantaggio di fornire applicazioni sia diagnostiche che terapeutiche, è per questo motivo che ciascuno centro di chirurgia bariatrica debba disporre di un centro di endoscopia operativa capace di trattare i diversi tipi di complicanze.

## References

1. Parikh NI, Pencina MJ, Wang TJ, Lanier KJ, Fox CS, D'Agostino CS, et al.: *Increasing trends in incidence of overweight and obesity over 5 decades*. Am J Med, 2007; 120(3)242-50.
2. Marmot M, Atinmo T, Byers T, Chen J, Hirohata T, Jackson A, et al.: *Food, nutrition, physical activity, and the prevention of cancer: A global perspective*. 2007.
3. Sinclair P, Brennan DJ, Le Roux CW: *Gut adaptation after metabolic surgery and its influences on the brain, liver and cancer*. Nat Rev Gastroenterol Hepatol, 1; 2018.
4. Bout-Tabaku S, Gupta R, Jenkins TM, Ryder JR, Baughcum AE, Jackson RD, et al.: *Musculoskeletal pain, physical function, and quality of life after bariatric surgery*. Pediatrics, 2019.
5. Shi X, Karmali S, Sharma AM, Birch DW: *A review of laparoscopic sleeve gastrectomy for morbid obesity*. Obes. Surg, 2010; 20(8) 1171-1177.
6. Kheirvari M, Dadkhah Nikroo N, Jaafarinejad H, Farsimadan M, Eshghjoo S, Hosseini S, Anbara T: *The advantages and disadvantages of sleeve gastrectomy; clinical laboratory to bedside review*. Heliyon, 2020.
7. Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W,

- Fahrbach K, et al.: *Bariatric surgery: A systematic review and meta-analysis*. JAMA, 2004; 292(14):1724-37.
8. Christou NV, Sampalis JS, Liberman M, Look D, Auger S, McLean AP, et al.: *Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients*. Ann Surg, 2004; 240(3):416-23; discussion 423-24.
9. Sjostrom L, Narbro K, Sjostrom CD, Karason K, Larsson B, Wedel H, et al.: *Effects of bariatric surgery on mortality in Swedish obese subjects*. N Engl J Med, 2007; 357(8):741-52.
10. Tartaglia Nicola, Cianci Pasquale, Di Lascia Alessandra, Fersini Alberto, Ambrosi Antonio, Neri Vincenzo: *Laparoscopic antegrade cholecystectomy: a standard procedure?* Open medicine, 2016; 11:429-32, ISSN: 2391-5463, doi: <https://doi.org/10.1515/med-2016-0078>
11. Kara S, Habesoglu MA, Yabanoglu H: *Change of respiratory functions, the STOP-Bang questionnaire, and Epworth sleepiness scale after bariatric surgery*. Ann Ital Chir; 2020; 91:633-638. PMID: 33055387.
12. Angrisani L, Santonicola A, Iovino P, Vitiello A, Higa K, Himpens J, Buchwald H, Scopinaro N: *IFSO Worldwide Survey 2016: Primary, endoluminal, and revisional procedures*. Obes Surg, 2018; 28:3783-3794.
13. Anania G, Agresta F, Artioli E, Rubino S, Resta G, Vettoretto N, Petz WL, Bergamini C, Arezzo A, Valpiani G, Morotti C, Silecchia G: *SICE CoDIG (Colon Dx Italian Group). Laparoscopic right hemicolectomy: the SICE (Società Italiana di Chirurgia Endoscopica e Nuove Tecnologie) network prospective trial on 1225 cases comparing intra corporeal versus extra corporeal ileo-colic side-to-side anastomosis*. Surg Endosc, 2020; 34(11):4788-4800. doi: 10.1007/s00464-019-07255-2. Epub 2019 Nov 18. Erratum in: Surg Endosc. 2019 Dec 12; PMID: 31741153; PMCID: PMC7572335.
14. Yormaz S, Yilmaz K, Alptekin H, Ece I, Acar F, Colak B, Kafali ME, Sahin E, Sahin M: *Does digestive symptoms require esophago gastroscopy prior to bariatric procedure? Assessment of 6 years' experience*. Ann Ital Chir, 2018; 89:36-44. PMID: 29629892.
15. Sharma P, McCarty TR, Lange A, Ngu JN, Njei B: *Impact of bariatric surgery on outcomes of patients with celiac disease: A nationwide inpatient sample analysis, 2004-2014*. Ann Gastroenterol, 2019; 32(1):73-80.
16. Vilallonga R, Hidalgo M, Garcia Ruiz de Gordejuela A, Caubet E, Gonzalez O, Ciudin A, Rodriguez-Luna MR, Roriz-Silva R, Petrola C, Armengol M, Fort JM: *Operative and postoperative complications of laparoscopic sleeve gastrectomy in super and nonsuper obese patients: a center of excellence experience comparative study*. J Laparoendosc Adv Surg Tech A, 2020.
17. Sjöström CD, Lissner L, Wedel H, Sjöström L: *Reduction in incidence of diabetes, hypertension and lipid disturbances after intentional weight loss induced by bariatric surgery: the SOS Intervention Study*. Obes Res, 1999; 7: 477-484 [PMID: 10509605]
18. Flum DR, Belle SH, King WC, Wahed AS, Berk P, Chapman W, Pories W, Courcoulas A, McCloskey C, Mitchell J, Patterson E, Pomp A, Staten MA, Yanovski SZ, Thirlby R, Wolfe B: *Perioperative safety in the longitudinal assessment of bariatric surgery*. N Engl J Med, 2009; 361:445-54 [PMID: 19641201 DOI: 10.1056/NEJMoa 0901836]
19. Adams TD, Davidson LE, Litwin SE, Kolotkin RL, LaMonte MJ, Pendleton RC, Strong MB, Vinik R, Wanner NA, Hopkins PN, Gress RE, Walker JM, Cloward TV, Nuttall RT, Hammoud A, Greenwood JL, Crosby RD, McKinlay R, Simper SC, Smith SC, Hunt SC: *Health benefits of gastric bypass surgery after 6 years*. JAMA 2012; 308: 1122-1131 [PMID: 22990271 DOI: 10.1001/2012.jama.11164]
20. Yimcharoen P, Heneghan HM, Tariq N, Brethauer SA, Kroh M, Chand B: *Endoscopic stent management of leaks and anastomotic strictures after foregut surgery*. Surg Obes Relat Dis, 2011; 7: 628-36 [PMID: 21798816 DOI: 10.1016/j.soard.2011.03.017]
21. Tartaglia N, Pavone G, Di Lascia A, Vovola F, Maddalena F, Fersini A, Pacilli M, Ambrosi A: *Robotic voluminous paraesophageal hernia repair: A case report and review of the literature*. Journal of medical case reports, 2020; 14(1), 25. <https://doi.org/10.1186/s13256-020-2347-6>
22. Morales MP, Miedema BW, Scott JS, de la Torre RA: *Management of postsurgical leaks in the bariatric patient*. Gastrointest Endosc Clin N Am, 2011; 21: 295-304 [PMID: 21569981 DOI:10.1016/j.giec.2011.02.008]
23. Aurora AR, Khaitan L, Saber AA: *Sleeve gastrectomy and the risk of leak: A systematic analysis of 4,888 patients*. Surg Endosc, 2012; 26: 1509-1515 [PMID: 22179470 DOI: 10.1007/s00464-011-2085-3]
24. Brethauer SA: *Sleeve gastrectomy*. Surg Clin North Am, 2011; 91: 1265-1279, ix [PMID: 22054153 DOI: 10.1016/j.suc.2011.08.012]
25. Ricci A, Di Vitantonio H, De Paulis D, Del Maestro M, Raysi SD, Murrone D, Luzzi S, Galzio RJ: *Cortical aneurysms of the middle cerebral artery: A review of the literature*. Surg Neurol Int, 2017; 8:117. doi:10.4103/sni.sni\_50\_17
26. Hughes D, Hughes I, Khanna A: *Management of staple line leaks following sleeve gastrectomy. A systematic review*. Obes Surg, 2019; 29(9):2759-2772. doi: 10.1007/s11695-019-03896-3. PMID: 31062278
27. Moloney BM, Hynes DA, Kelly ME, Iqbal A, O'Connor E, Lowe D, et al.: *The role of laparoscopic sleeve gastrectomy as a treatment for morbid obesity: Review of outcomes*. Ir J Med Sci, 2017; 186(1):143-49.
28. Spicka P: *Staple line leak with peritonitis after laparoscopic sleeve gastrectomy. A solution in one to six steps*. Wideochir Inne Tech Maloinwazyjne, 2017; 12(2):154-59.
29. Rawlins L, Rawlins MP, Brown CC, Schumacher DL: *Sleeve gastrectomy: 5-year outcomes of a single institution*. Surg Obes Relat Dis, 2013; 9(1):21-5.
30. Albanopoulos K, Alevizos L, Linardoutsos D, Menenakos E, Stamou K, Vlachos K, et al.: *Routine abdominal drains after laparoscopic sleeve gastrectomy: A retrospective review of 353 patients*. Obes Surg, 2011; 21(6):687-91.
31. Keren D, Eyal O, Sroka G, Rainis T, Raziel A, Sakran N, et al.: *Over-The-Scope Clip (OTSC) system for sleeve gastrectomy leaks*. Obes Surg, 2015; 25(8):1358-63.
32. Casella G, Soricelli E, Rizzello M, Trentino P, Fiocca F, Fantini A, et al.: *Non surgical treatment of staple line leaks after laparoscopic sleeve gastrectomy*. Obes Surg, 2009; 19(7):821-26.
33. El-Sayes IA, Frenken M, Weiner RA: *Management of leakage and stenosis after sleeve gastrectomy*. Surgery, 2017; 162(3):652-61.



34. Leeds SG, Burdick JS: *Management of gastric leaks after sleeve gastrectomy with endoluminal vacuum (E-Vac) therapy*. *Surg Obes Relat Dis*, 2016; 12(7):1278–85.
35. AbdEllatif ME, Abdallah E, Askar W, Thabet W, Aboushady M, Abbas AE, et al.: *Long term predictors of success after laparoscopic sleeve gastrectomy*. *Int J Surg*, 2014; 12(5):504–8.
36. Gibson SC, Le Page PA, Taylor CJ: *Laparoscopic sleeve gastrectomy: Review of 500 cases in single surgeon Australian practice*. *ANZ J Surg*, 2015; 85(9):673–77.
37. Hoogerboord M, Wiebe S, Klassen D, Ransom T, Lawlor D, Ellsmere J: *Laparoscopic sleeve gastrectomy: Perioperative outcomes, weight loss and impact on type 2 diabetes mellitus over 2 years*. *Can J Surg*, 2014; 57(2):101–05.
38. Szewczyk T, Janczak P, Janiak A, Gaszynski T, Modzelewski B: *Laparoscopic sleeve gastrectomy. 7 years of own experience*. *Wideochir Inne Tech Maloinwazyjne*, 2014; 9(3):427–35.
39. Curro G, Piscitelli G, Lazzara C, et al.: *Laparoscopic sleeve gastrectomy for morbid obesity: Role of intraluminal and intraperitoneal postoperative drainage*. *G Chir*, 2017; 38(4):181–84.
40. Wahby M, Salama AF, Elezaby AF, et al.: *Is routine postoperative gastrografin study needed after laparoscopic sleeve gastrectomy? Experience of 712 cases*. *Obes Surg*, 2013; 23(11):1711–1717.
41. Rossetti G, Fei L, Docimo L, Del Genio G, Micanti F, Belfiore A, et al.: *Is nasogastric decompression useful in prevention of leaks after laparoscopic sleeve gastrectomy? A randomized trial*. *J Invest Surg*, 2014; 27(4):234–39.
42. Sethi M, Zagzag J, Patel K, Magrath M, Somoza E, Parikh MS, et al.: *Intraoperative leak testing has no correlation with leak after laparoscopic sleeve gastrectomy*. *Surg Endosc*, 2016; 30(3):883–91. 26.
43. Montuori M, Benavoli D, D’Ugo S, Di Benedetto L, Bianciardi E, Gaspari AL, et al.: *Integrated approaches for the management of staple line leaks following sleeve gastrectomy*. *J Obes*, 2017; 2017:4703236.
44. Klimczak T, Klimczak J, Szewczyk T, Janczak P, Juralowicz P: *Endoscopic treatment of leaks after laparoscopic sleeve gastrectomy using MEGA esophageal covered tents*. *Surg Endosc*, 2018; 32(4):2038–45.
45. Southwell T, Lim TH, Ogra R: *Endoscopic therapy for treatment of staple line leaks post-laparoscopic sleeve gastrectomy (LSG): Experience from a large bariatric surgery centre in new zealand*. *Obes Surg*, 2016; 26(6):1155–162.
46. Behrens C, Tang BQ, Amson BJ: *Early results of a Canadian laparoscopic sleeve gastrectomy experience*. *Can J Surg*, 2011; 54(2):138–43.
47. Weiner RA, El-Sayes IA, Theodoridou S, et al.: *Early post-operative complications: incidence, management, and impact on length of hospital stay. A retrospective comparison between laparoscopic gastric bypass and sleeve gastrectomy*. *Obes Surg*, 2013; 23(12):2004–12.
48. Hany M, Ibrahim M: *Comparison between staple line reinforcement by barbed suture and non-reinforcement in sleeve gastrectomy: A randomized prospective controlled study*. *Obes Surg*, 2018; 28(8):2157–64.
49. Nocca D, Krawczykowsky D, Bomans B, Noel P, Picot MC, Blanc PM, et al.: *A prospective multicenter study of 163 sleeve gastrectomies: Results at 1 and 2 years*. *Obes Surg*, 2008; 18(5):560–65.
50. Skrekas G, Lapatsanis D, Stafyla V, Papalambros A: *One year after laparoscopic “tight” sleeve gastrectomy: Technique and outcome*. *Obes Surg*, 2008; 18(7):810–13.
51. Csendes A, Braghetto I, Leon P, Burgos AM: *Management of leaks after laparoscopic sleeve gastrectomy in patients with obesity*. *J Gastrointest Surg*, 2010; 14(9):1343–48.
52. Dapri G, Cadriere GB, Himpens J: *Reinforcing the staple line during laparoscopic sleeve gastrectomy: Prospective randomized clinical study comparing three different techniques*. *Obes Surg*, 2010; 20(4):462–67.
53. Rosenthal RJ, Diaz AA, 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(1):8–19.
54. Kwon YM, Gerdes H, Schattner MA, et al.: *Management of peripancreatic fluid collections following partial pancreatectomy: A comparison of percutaneous versus EUS-guided drainage*. *Surg Endosc*, 2013; 27(7):2422–27.
55. Tilara A, Gerdes H, Allen P, et al.: *Endoscopic ultrasound-guided transmural drainage of postoperative pancreatic collections*. *J Am Coll Surg*, 2014; 218(1):33–40.
56. Donatelli G, Fuks D, Cereatti F, et al.: *Endoscopic transmural management of abdominal fluid collection following gastrointestinal, bariatric, and hepato-bilio-pancreatic surgery*. *Surg Endosc*, 2018; 32(5):2281–87.
57. Campos JM, Pereira EF, Evangelista LF, et al.: *Gastrobronchial fistula after sleeve gastrectomy and gastric bypass: Endoscopic management and prevention*. *Obes Surg*, 2011; 21(10):1520–29.
58. Cosse C, Rebibo L, Brazier F, et al.: *Cost-effectiveness analysis of stent type in endoscopic treatment of gastric leak after laparoscopic sleeve gastrectomy*. *Br J Surg*, 2018; 105(5):570–77.
59. Scopinaro N: *A rational look at the apparent mess of bariatric surgery procedures and indications*. *Ann Ital Chir*, 2007; 78(6):463–7. PMID: 18510023.
60. Tartaglia N, Pavone G, Petruzzelli F, Di Lascia A, Vovola F, Maddalena F, Cianci P, Fersini A, Pacilli M, Ambrosi A: *Robotic sleeve gastrectomy vs laparoscopic sleeve gastrectomy: Our preliminary experience and a literature review*. *Clinical and Experimental Surgery. Petrovsky Journal*. 2020; 8 (4): 7–15. DOI: <https://doi.org/10.33029/2308-1198-2020-8-4-7-15>
61. Ferreira LE, Song LM, Baron TH: *Management of acute post-operative hemorrhage in the bariatric patient*. *Gastrointest Endosc Clin N Am*, 2011; 21: 287–294 [PMID: 21569980 DOI: 10.1016/j.giec.2011.02.002]
62. Jamil LH, Krause KR, Chengelis DL, Jury RP, Jackson CM, Cannon ME, Duffy MC: *Endoscopic management of early upper gastrointestinal hemorrhage following laparoscopic Roux-en-Y gastric bypass*. *Am J Gastroenterol*, 2008; 103: 86–91 [PMID 17941960 DOI: 10.1111/j.1572-0241.2007.01588.x]
63. Rabl C, Peeva S, Prado K, James AW, Rogers SJ, Posselt A, Campos GM: *Early and late abdominal bleeding after Roux-en-Y gastric bypass: Sources and tailored therapeutic strategies*. *Obes Surg*, 2011; 21: 413–420 [PMID: 21240659 DOI: 10.1007/s11695-011-0354-9]



64. Alexander JW, Rahn R, Goodman HR: *Prevention of surgical site infections by an infusion of topical antibiotics in morbidly obese patients*. Surg Infect (Larchmt), 2009; 10(1):53-7.
65. Freeman JT, Anderson DJ, Hartwig MG, Sexton D: *Surgical site infections following bariatric surgery in community hospitals: A weighty concern?* Obes Surg, 2011; 21(7):836-40.
66. Singhal R, Tahrani AA, Ludwig C, Mahawar K; GENEVA collaborators: *Global 30-day outcomes after bariatric surgery during the COVID-19 pandemic (GENEVA): an international cohort study*. Lancet Diabetes Endocrinol, 2021; 9(1):7-9. doi: 10.1016/S2213-8587(20)30375-2. Epub 2020 Nov 27. PMID: 33253631; PMCID: PMC7832244.
67. Fischer MI, Dias C, Stein AT, Meinhardt NG, Heineck I: *Antibiotic prophylaxis in obese patients submitted to bariatric surgery. A systematic review*. Acta Cir Bras, 2014; 29(3):209-17.
68. Mena Boules, Julietta Chang, Ivy N Haskins, Gautam Sharma, DvirFroylich, Kevin El-Hayek, John Rodriguez, Matthew Kroh: *Endoscopic management of post-bariatric surgery complications*. World J Gastrointest Endosc, 2016; 8(17), 591-99.

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