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Assessment of Surgical Complications in Morbid Obese Patients, The Candidates for 2 Methods of Laparoscopic Bariatric Surgery (Laparoscopic Gastric Bypass, Laparoscopic Sleeve Gastrectomy)

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Abstract

Background: In 2005, obesity rate was declared 396 million worldwide, which has been doubled in the last 20 years (compared with 1985). Obesity has a strong correlation with a pool of comorbidities and consequences. Although many modules, including behavioural approach and medications have presented particular short-term unreliable methods to reduce and control the body weight in morbid obesity, only 5 - 10% of weight loss was achieved, which is usually regained overtime, compared with 50 - 75% success rate in bariatric surgery.
Objectives: This retrospective study tried to monitor weight loss after LRYGB and LSG in morbid obese patients referred to a known center in Tehran through a one-year follow up.
Materials and Methods: Participants were selected regarding the U.S. National Institute of Health (NIH) guidelines, which indicates BMI > 40 kg/m^2 alone, or BMI > 35 kg/m^2 in addition to comorbidities and failure of non-surgical attempts to control their weight. They were visited at points of one, three, six, and 12 months postoperatively to collect information about weight loss, BMI, and complications in addition to percent excess weight loss (EWL%). The percentage of failure was computed to the proportion of patients who had EWL% < 25 to the total number of operated patients in a year.
Results: Significant decrease in BMI and weight were achieved in all postoperative visits (for all of them, P value < 0.0001), while no significant difference was found in which the parameters between two studied procedures were in this regard.
Conclusions: To sum up, LRYGB and LSG deserve an overall preference not only in current study, but also in the majority of performances up to now. Nevertheless it is urgent the relevant studies to confirm the preference or improve this kind of bariatric surgery in order to diminish complications as far as possible.

Keywords: Obesity, Morbid, LRYGB, LSG, Iran

1. Background

In 2005 obesity rate was declared 396 million worldwide, which has been doubled in the last 20 years (compared with 1985) (1, 2). They also estimated an obesity rate of 500 million in 2030, which is equal to the prevalence of obesity in 2008 provided by the WHO, including 300 million women and 200 million men globally (3, 4). In Canada, there has been a fourfold increase in extreme obesity only in last two decades (5, 6), while in Iran, obesity in 2005 was computed just lower than 50% in average with a big difference between two genders (42.8% in men vs. 57% in women,) (7). Authorities also estimate a 1.3 times increase in 2015 for Iranians (8).

Hosseinpanah et al. concluded an age adjusted obesity rate of 14.4% and 22.9% for men and women in 2009 which was growing from a total average of 18.65% in that year to 19.7% (age and sex adjusted) in 2011 (1). Of course according to the World Health Organization (WHO) the prevalence of overweight and obesity in Iran in 2014 were 62.7% and 26.1% respectively [WHO]. Interestingly, the most common group of obesity in Iran was men in their 30's and women in their 6th decade of living (1). The prevalence of obesity is sharply rising in elderly patients (9, 10), who are often considered as a high risk group prone to much more comorbidities and complications in this regard. As a matter of fact, there has been an obvious worldwide growth in the rate of obesity during recent few decades leading to emerge the rate of morbid cases and is undoubtedly a great inevitable threat to human life, if not managed (11, 12).

Obesity correlates with a pool of comorbidities and consequences. It is also a well-known independent risk factor of diabetes mellitus, cancer, cardiovascular diseases, hypertension, lipid disorders, obstructive sleep apnoea (OSA), metabolic syndrome, early osteoarthritis, gall

bladder diseases and of course sudden death, mostly in early ages (3, 13-20). All cancers, except from oesophagus and prostate, are somehow observed in morbid obese patients, as authors reclaimed (21, 22). Even some estimate only a 5 to 20 years of life-expectancy for severe obese or super-super obese patients unfortunately (23, 24).

Although many modules including behavioural approach and medications have been presented some short-term unreliable methods to reduce and control body weight, only 5 - 10% weight loss was achieved, which is usually regained overtime (25, 26). Obese people are more likely to neglect scheduled weight loss programs, regardless of physical or medical procedures, which is almost always the reason that they do not receive suitable results, while bariatric surgery provides 50 - 75% weight loss and is known as the most effective treatment in morbid obesity (27-30). By means of reducing the mortality and morbidity, bariatric surgery is going to leave other nonsurgical ways behind, especially nowadays that more experience and confidence have been achieved and many techniques, such as laparoscopy, have been described to make procedures safer and more adopted, even for elderly patients (17, 18, 25, 28, 31-33). Not only the obesity itself, but also main comorbidities mentioned above are affected positively by bariatric surgery (30). Introducing laparoscopy has dramatically attracted global welcome, especially in Asian experts and researchers, who usually deny open surgeries, particularly in older people, who face a fourfold obesity rate compared with younger groups (34, 35).

Among laparoscopic approaches, laparoscopic Roux-en-Y gastric bypass (LRYGB), laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG), are commonly mentioned (19, 31), and among them, the former is the most familiar one in the United States contributing 88% of all procedures in 2002 (36) and 70% of worldwide intervention in 2006 (37). It was firstly described in 1966 (5, 18) and is frequently pointed out as the gold standard in this regard, mainly because of its superior results, including long-term satisfaction, as well as acceptable remission in comorbidities and even resolving them (11, 19, 25, 38, 39).

2. Objectives

This retrospective study tried to monitor weight loss after LRYGB and LSG in morbid obese patients referred to the obesity clinic of Rasoul-e-Akram Hospital of Iran Medical University in Tehran through a one-year follow up.

3. Patients and Methods

3.1. Study Setting and Participants

to evaluate short and middle-term outcomes of LRYGB, this study was designed in a referral clinic and research center of minimally invasive surgery for morbid obesity enrolling eligible patients, according exclusion criteria as follows, although we did not have any criteria to exclude the participants:

Major depression, psychosis, alcoholism, opioid addiction.

Participants were selected regarding the U.S. National Institute of Health (NIH) guidelines, which indicates BMI > 40 kg/m^2 alone, or BMI > 35 kg/m^2 in addition to comorbidities and failure of non-surgical attempts to control weight (39).

3.2. Intervention and Technique

This study recruited a single surgeon to do the LRYGB for two years and to superwise also the one-year follow up activities for each patient. The techniques of the procedure were the same throughout the study. Vital signs, electrolytes, lipid profile and infections, as well as blood sugar were checked before starting the operation. The first 10-mm trocar inserted 20 cm below the xiphoid process to fix a 30° telescope. Then trocars with 12-mm diameters were placed in the two sides of hypo-gastric areas. Liver retraction was conducted by the fifth trocar when placed below the first one before devising up the omentum majus to the middle colon transversum. The small bowel was fixed to the gastric corpus 50 - 75 cm below the angle of Treitz (38, 40-42). Vertical orientation has remained constant throughout the operation and the pouch size was considered 25 - 35 cm^3. For all of the procedures biliopancreatic limb was uniformly 40 cm and the length of the RyGB limb were 100 and 150 cm regarding BMI less or more than 50, respectively. Concerning Roux limbs, retrogastric tunnel was devised at the minor curve to form 25 - 35 cm^3 pouches. The Ileo-juojenal anastomosis was done with sutures at 50 cm distal to the beginning point to leave a comfortable length of mesenterium as advised. A continuous stitch of 3 - 0 Vicril® was used to seal the bowel incision before posing the patient in a reverse trendelenburg position (38). Circular end-to-side anastomosis endoluminal stapler technique was preferred for gastrojuojenostomy (38). The rest of the technique followed Gagner's method (38, 40-42).

All of the patients stayed at least for two days with soft diet to ensure about acceptable bowel function. Hormonal study, liver function test, echocardiography, psychological examination, gastroscopy and ultrasound were ready to identify any short-term complications (38).

The participants were visited at points of one, three, six, and 12 months postoperatively to collect information about weight loss, BMI, complications and satisfaction, in addition to percent excess weight loss (EWL%). The percentage of failure was computed to the proportion of patients who had EWL% < 25 to the total number of operated patients in a year.

3.3. Statistics

Continuous variables are presented as mean (SD) and qualitative variables are reported through frequencies (percentage). The Independent t-test was used to compare means of continues outcomes between two groups. We also used Analysis of covariance (ANCOVA) for comparing mean of post-operative continues outcomes by adjustment on pre-operative results.

The paired t-test was used to compare preoperative and postoperative values within two groups. Also Pearson coefficient test was used to analyze correlations. Statistical analysis was performed using SPSS 20.0 software (SPSS Inc., Chicago, IL, USA). P values less than 0.05 were considered statistically significant.

3.4. Ethics

Although no conflict was concerned, all of the participants had signed informed consents routinely which described that the data would be used in research publications without showing patients' individual or private characteristics and information.

4. Results

Out of 2401 morbid obese patients, 24 records were excluded due to imperfect data. This study does not report relevant data for all 2377 profiles, but it show a brief demography of all referrals in addition to detailed findings of 426 cases underwent bariatric surgery.

The mean age of all eligible patients to be operated was 38.09 ± 12.45 years with a mean weight of 109.24 ± 26.85 kg at first visit. Body mass index (BMI) had a mean of 39.45 ± 10.62. For all patients, 2010 were female. When feeding behavior was concerned, the data showed sweet eaters (61%) followed by emotional eaters who contributed 60.7% of them. Obviously, each patient could have multiple behaviours as dominant one; No one reported eating at night; However, volume eaters and snack eaters illustrated the same rate around 40%.

Among 420 patients who took part in surgical management and completed one-year follow up, regardless of special indication criteria or patients willing, the most applied technique was LRYGB with a rate of 85% (367 cases), and 15% of LSG (No = 53). The mean age was 38.53 ± 9.69 in LRYGB. Males were 47 (12.6%) whilst females were 320 (87%), in the LRYGB group primary patient's weight was 119.58 ± 17.77 with the mean height of 163.81 ± 8.03. The response rate of followed patients decreased from 36% in month three to 24% at the end of follow up time.

Significant decrease in BMI and weight were achieved in all postoperative visits within each group, while no significant difference was found between the two studied procedures in this regard (Table 1).

Pearson coefficient test evaluated all correlations between the rate of losing weight and BMI with patients' primary weight and distinguished complete dependence at all points of follow up, except for LSG group at 12-month visit, which failed to have significant correlation between 12-month weight loss and patients' primary weight and BMI, while BMI in LSG group had entirely significant decrease (Table 2). Table 2 also shows percent EWL for the two evaluated techniques that identify the success rate of surgery at three time points of follow up. Concerning EWL%, the rate in both groups of LRYGB and LSG was increasing as time passed (e.g. from 47 in 3 months to more than 72 during 12 months following LRYGB). When the failure rate in achieving ideal weight loss is concerned, the final findings, according to the formula of failure rate, reported 6.04% in month 3; 0.91% in month 6 and 0.00 for month 12 after LRYGB. These proportions for LSG except in month 3 (4.73%) were 0.00.

Table 1. Weight Loss and BMI Through LRYGB and LSG[a,b]

Follow Up Periods, mo	Intervention	
	LRYGB	LSG
Weight loss		
3	23.17 ± 10.82	25.2 ± 9.96
6	31.43 ± 9.46	34.99 ± 11.04
12	37.74 ± 10.51	38.01 ± 9.35
Weight loss		
3	36 ± 5	40 ± 8
6	33 ± 5	35 ± 8
12	31 ± 4.5	33 ± 7

[a]Abbreviations: LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy.
[b]Data are presented as mean ± SD.

Table 2. Effect of Surgery on Weight and BMI Comparing to Early Amounts of Them When the Study Started[a,b]

Follow Up Periods, mo	EWL	P Values	
		Correlation With Primary Weight	Correlation With Primary BMI
LRYGB group			
3	46.99 ± 23.90	< 0.001	< 0.001
6	61.20 ± 17.15	< 0.001	< 0.001
12	72.50 ± 18.90	< 0.001	< 0.001
LSG group			
3	41.00 ± 11.65	<0.001	< 0.001
6	62.21 ± 20.97	0.012	0.002
12	71.63 ± 23.97	0.066	0.102

[a]Abbreviations: LRYGB, laparoscopic Roux-en-Y gastric bypass; LSG, laparoscopic sleeve gastrectomy.
[b]Data are presented as mean ± SD.

5. Discussion

Our findings showed a significant decrease in weight and BMI without any differences between the two procedures named, LRYGB and LSG. This is obvious that many morbid obese people try several ways to control their weight among which diet, medications, traditional remedies, and behavioral modifications are the most advised ones. Our patients were not exceptions from the common mentioned attempts to lose weight. However, no obvious results were achieved through non-surgical interventions, whilst operations lead to relatively most acceptable outcomes in this regard. Our study was not exactly comparing the two techniques, but reporting separate findings related to them. On the contrary, many studies have been comparing different surgical techniques to introduce the best one. Previous studies showed open RYGB is a successful method in weight loss and decreeing mortality and comorbidities (39, 43). The current report mentioned the mean weight loss through this procedure more than 20 kg in 3 months to more than 35 kg after a year of operation in LRYGB group, not statistically different to LSG. The results were very close to an Iranian study ending in 2008 (39). This was the same for BMI loss up to 30 kg/m^2. We reported EWL% of 72.5 ± 19 by LRYGB and 72 ± 24 by LSG after a year.

Nguyen et al. reported more than 65% EWL in LRYGB compared with 45% for LAGB during a 4-year follow up (44) through which 15 kg/m^2 and 11.8 kg/m^2 fall were observed in BMI by LRYGB and LAGB, respectively; with no failure (defined as EWL% < 20) (44). This is incredibly like Angrisani's work (45). Spivak et al. (11) reported 70% EWL after a year. Boza et al. supports also the superior effectiveness of LRYGB (46). In the current study numbers of the applied procedures were not equal or at least comparable. So, we could not prefer any technique statistically. Interestingly, positive role of male gender and young age is described by some authors (39). Nowadays, a majority of researches are attracted to find a resolution for comorbidities of morbid obesity, as a worthy aspect of accessory effectiveness of bariatric surgery. We did not monitor patients comorbidities, such as diabetes mellitus, cardiovascular disease or hyperlipidemia, etc. but it sounds worth noting that a major study by national institute of health of the United States (NIH) evaluated more than 25,000 patients for a year, of them, just less than 15000 experienced LRYGB and just less than 1000 underwent LSG (47). This performance was actually like our effort in terms of which proportions of patients took part in two groups of LRYGB and LSG, in addition to the time of follow up at 3, 6, and 12 months of operations. So, we considered a lack of fulfilling and using the information about comorbidities in our research work. Otherwise, we did not face any mortality unlike NIH study, which reported it in 0.12% with higher incidence for LRYGB. It could be led by big number of patients compared to us. Actually, the current work focused on weight and BMI changes as the main outcomes and since our study was the first report of the center directing principal investigators to prefer to include more variables later despite existed in the charts. Finally, to the best of our knowledge, almost all authorities unanimously confirm that bariatric surgeries always obviate diabetes mellitus, hypertension, hyperlipidemia, obstructive sleep apnea (OSA), and even gastro-esophageal reflux disorder (GERD) (5, 18, 19, 25, 31, 47-49), while Himpens et al. in 2012 raise that developed diabetes mellitus type II tends to have a new onset several years after the by LRYGB operation, although the quality of life is acceptable and remains quite high for a long period (50).

All our patients were checked for any short- or middle-term complications (data were not shown) and concerning common complications of LRYGB, we found no threatening perioperative event and also during one year of follow up. Intra-abdominal bleeding and hematoma was common in Spivak's operations leading to evacuation and blood transfusion. Zuegel et al. (38) reports a total rate of 12% complication for LRYGB, while pointing out up to 30% rate in previous studies (42, 44, 51-53). Furthermore, he shows a 1% rate of small bowel obstruction compared with 3.2% expressed by others (38, 52). Ulceration followed by stenosis of small stomach, anastomosis stenosis and bowel obstruction are the most frequent late complications of LRYGB, which we faced none of them, unlike Zuegel et al. that reported a rate of 3.6% rate (38). Despite the higher rate and more serious complications in the case of LRYGB, the overall cost-effectiveness seems to be superior compared with LAGB, as authors reclaim (38, 51, 54, 55). It is worth rising that the NIH believes that LSG had higher rates of organ space infection, renal insufficiency and sepsis but lower occurrence of ventilator dependence than LRYGB (47).

This research work could not compare the effectiveness of the two procedures unlike DeMaria et al. (56) and Weber et al.,(11, 57) who found LRYGB superior to LAGB. Otherwise, some blame the former in long-term outcome, because of more regaining weight overtime compared to LAGB (58-60). According to non-comparable characters of our study, there is no place to dive into the matter anymore.

Concerning the patients' response rate during follow up time, this study showed a downward trend starting from the first postoperative session than the next year of the surgery. It decreased 12% a year in average and finally 24% at the end of follow up compared with 16% after 2 years in Lee's et al. report (31). To the best of our knowledge, the best response rate has been given in Toulabi's follow up with 68 - 83% during 6 months (39). Our patients had a mean primary weight just less than 120 kg, which is very close to what Spivak et al. (11) did through enrolling one hundred patients to compare LRYGB and LAGB. Spivak indicates no life threatening complications in LAGB group, but 9% in the other procedure (11).

To sum up, LRYGB deserves an overall preference not

only in the current study, but also in the majority of performances up to now, although it sounds that relevant studies need to confirm the preference or to improve this kind of bariatric surgery in order to diminish complications as far as possible.

Footnotes

Authors' Contribution: Study concept and design: Abdolreza Pazouki, Mohammadreza Abdolhosseini, Peyman Alibeigi; acquisition of data: Somayyeh Mokhber, Sajedeh Riazi; analysis and interpretation of data: Somayyeh Mokhber, and Sajedeh Riazi; drafting of the manuscript: Fatemeh Jesmi, Somayyeh Mokhber, Sajedeh Riazi, Mohammadreza Abdolhosseini, and Peyman Alibeigi; critical revision of the manuscript for important intellectual content: Abdolreza Pazouki; statistical analysis: Fatemeh Jesmi; administrative, technical, and material support: Abdolreza Pazouki, Mohammadreza Abdolhosseini, and Peyman Alibeigi; study supervision: Abdolreza Pazouki, Mohammadreza Abdolhosseini, Peyman Alibeigi, Somayyeh Mokhber, Sajedeh Riazi.

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References

1. Hosseinpanah F, Barzin M, Eskandary PS, Mirmiran P, Azizi F. Trends of obesity and abdominal obesity in Tehranian adults: A cohort study. *BMC Public Health.* 2009;**9**:426. doi: 10.1186/1471-2458-9-426. [PubMed: 19930614]
2. Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes (Lond).* 2008;**32**(9):1431–7. doi: 10.1038/ijo.2008.102. [PubMed: 18607383]
3. Lomanto D, Lee WJ, Goel R, Lee JJ, Shabbir A, So JB, et al. Bariatric surgery in Asia in the last 5 years (2005-2009). *Obes Surg.* 2012;**22**(3):502–6. doi: 10.1007/s11695-011-0547-2. [PubMed: 22033767]
4. World Health Organization. *Obesity and overweight.* 2011. Available from: http://www.who.int/mediacentre/factsheets/fs311/ en/ http://www.who.int/mediacentre/factsheets/fs311.
5. Griffith PS, Birch DW, Sharma AM, Karmali S. Managing complications associated with laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Can J Surg.* 2012;**55**(5):329–36. doi: 10.1503/cjs.002011. [PubMed: 22854113]
6. Katzmarzyk PT, Mason C. Prevalence of class I, II and III obesity in Canada. *CMAJ.* 2006;**174**(2):156–7. doi: 10.1503/cmaj.050806. [PubMed: 16415457]
7. Janghorbani M, Amini M, Willett WC, Mehdi Gouya M, Delavari A, Alikhani S, et al. First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. *Obesity (Silver Spring).* 2007;**15**(11):2797–808. doi: 10.1038/oby.2007.332. [PubMed: 18070771]
8. World Health Organization. Chronic deaseases are the major cause of death and disability worldwide. Available from: http://www.who.int/ chp/chronic_disease_report/media/http://www.who.int.
9. Alegria Ezquerra E, Castellano Vazquez JM, Alegria Barrero A. [Obesity, metabolic syndrome and diabetes: Cardiovascular implications and therapy]. *Rev Esp Cardiol.* 2008;**61**(7):752–64. [PubMed: 18590648]
10. Hirani V, Zaninotto P, Primatesta P. Generalised and abdominal obesity and risk of diabetes, hypertension and hypertension-diabetes co-morbidity in England. *Public Health Nutr.* 2008;**11**(5):521–7. doi: 10.1017/S1368980007000845. [PubMed: 17767799]
11. Spivak H, Abdelmelek MF, Beltran OR, Ng AW, Kitahama S. Long-term outcomes of laparoscopic adjustable gastric banding and laparoscopic Roux-en-Y gastric bypass in the United States. *Surg Endosc.* 2012;**26**(7):1909–19. doi: 10.1007/s00464-011-2125-z. [PubMed: 22219011]
12. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA.* 2010;**303**(3):235–41. doi: 10.1001/jama.2009.2014. [PubMed: 20071471]
13. Haslam DW, James WP. Obesity. *Lancet.* 2005;**366**(9492):1197–209. doi: 10.1016/S0140-6736(05)67483-1. [PubMed: 16198769]
14. Buchwald H, Williams SE. Bariatric surgery worldwide 2003. *Obes Surg.* 2004;**14**(9):1157–64. doi: 10.1381/0960892042387057. [PubMed: 15527627]
15. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *Int J Obes (Lond).* 2011;**35**(7):891–8. doi: 10.1038/ijo.2010.222. [PubMed: 20975725]
16. Franks PW, Hanson RL, Knowler WC, Sievers ML, Bennett PH, Looker HC. Childhood obesity, other cardiovascular risk factors, and premature death. *N Engl J Med.* 2010;**362**(6):485–93. doi: 10.1056/NEJMoa0904130. [PubMed: 20147714]
17. Obeid A, Long J, Kakade M, Clements RH, Stahl R, Grams J. Laparoscopic Roux-en-Y gastric bypass: Long term clinical outcomes. *Surg Endosc.* 2012;**26**(12):3515–20. doi: 10.1007/s00464-012-2375-4. [PubMed: 22684978]
18. Lynch J, Belgaumkar A. Bariatric surgery is effective and safe in patients over 55: A systematic review and meta-analysis. *Obes Surg.* 2012;**22**(9):1507–16. doi: 10.1007/s11695-012-0693-1. [PubMed: 22718467]
19. Henneman D, Lagarde S, Geubbels N, Tuynman J, Jensch S, Van Wagensveld B. Complications after Laparoscopic Roux-en-Y gastric bypass: A diagnostic challenge. Report of three cases and review of the literature. *G Chir.* 2012;**33**(6-7):209–17. [PubMed: 22958801]
20. Li Z, Bowerman S, Heber D. Health ramifications of the obesity epidemic. *Surg Clin North Am.* 2005;**85**(4):681–701. doi: 10.1016/j.suc.2005.04.006. [PubMed: 16061080]
21. Mor A, Keenan E, Portenier D, Torquati A. Case-matched analysis comparing outcomes of revisional versus primary laparoscopic Roux-en-Y gastric bypass. *Surg Endosc.* 2013;**27**(2):548–52. doi: 10.1007/s00464-012-2477-z. [PubMed: 22806534]
22. Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. *BMC Public Health.* 2009;**9**:88. doi: 10.1186/1471-2458-9-88. [PubMed: 19320986]
23. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *N Engl J Med.* 2006;**355**(8):763–78. doi: 10.1056/NEJMoa055643. [PubMed: 16926275]
24. Freedman DM, Ron E, Ballard-Barbash R, Doody MM, Linet MS. Body mass index and all-cause mortality in a nationwide US cohort. *Int J Obes (Lond).* 2006;**30**(5):822–9. doi: 10.1038/sj.ijo.0803193. [PubMed: 16404410]
25. Cutolo PP, Nosso G, Vitolo G, Brancato V, Capaldo B, Angrisani L. Clinical efficacy of laparoscopic sleeve gastrectomy vs laparoscopic gastric bypass in obese type 2 diabetic patients: a retrospective comparison. *Obes Surg.* 2012;**22**(10):1535–9. doi: 10.1007/s11695-012-0657-5. [PubMed: 22960950]
26. Klein S, Sheard NF, Pi-Sunyer X, Daly A, Wylie-Rosett J, Kulkarni K, et al. Weight management through lifestyle modification for the prevention and management of type 2 diabetes: rationale and strategies: A statement of the American diabetes association, the north american association for the study of obesity, and the american society for clinical nutrition. *Diabetes Care.* 2004;**27**(8):2067–73. [PubMed: 15277443]
27. Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, et al. Weight and type 2 diabetes after bariatric surgery: Systematic review and meta-analysis. *Am J Med.* 2009;**122**(3):248–256 e5. doi: 10.1016/j.amjmed.2008.09.041. [PubMed: 19272486]
28. Gastrointestinal surgery for severe obesity. *Consens Statement.* 1991;**9**(1):1–20. [PubMed: 1760489]
29. Hubbard VS, Hall WH. Gastrointestinal Surgery for Severe Obesity. *Obes Surg.* 1991;**1**(3):257–65. [PubMed: 10775921]

30. 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. doi: 10.1001/jama.292.14.1724. [PubMed: 15479938]
31. Lee DY, Guend H, Park K, Levine J, Ross RE, McGinty JJ, et al. Outcomes of laparoscopic Roux-en-Y gastric bypass versus laparoscopic adjustable gastric banding in adolescents. *Obes Surg.* 2012;**22**(12):1859–64. doi: 10.1007/s11695-012-0742-9. [PubMed: 22923312]
32. 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. [PubMed: 15319713]
33. Flum DR, Dellinger EP. Impact of gastric bypass operation on survival: A population-based analysis. *J Am Coll Surg.* 2004;**199**(4):543–51. doi: 10.1016/j.jamcollsurg.2004.06.014. [PubMed: 15454136]
34. World Health Organization. *Obesity and overweight.* 2003. Available from: http://www.who.int/hpr/NPH/docs/gs_obesity. pdf.
35. Arkinson J, Ji H, Fallah S, Perez J, Chen XK, Leeb K. Bariatric surgery in Canada: A focus on day surgery procedures. *Healthc Q.* 2010;**13**(3):15–8. [PubMed: 20523145]
36. Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. *JAMA.* 2005;**294**(15):1909–17. doi: 10.1001/jama.294.15.1909. [PubMed: 16234497]
37. Rosenthal RJ, Szomstein S, Kennedy CI, Soto FC, Zundel N. Laparoscopic surgery for morbid obesity: 1,001 consecutive bariatric operations performed at The Bariatric Institute, Cleveland Clinic Florida. *Obes Surg.* 2006;**16**(2):119–24. doi: 10.1381/096089206775565230. [PubMed: 16469210]
38. Zuegel NP, Lang RA, Huttl TP, Gleis M, Ketfi-Jungen M, Rasquin I, et al. Complications and outcome after laparoscopic bariatric surgery: LAGB versus LRYGB. *Langenbecks Arch Surg.* 2012;**397**(8):1235–41. doi: 10.1007/s00423-012-0945-5. [PubMed: 22430299]
39. Toolabi K, Arefanian S, Golzarand M, Arefanian H. Effects of laparoscopic Roux-en-Y gastric bypass (LRYGB) on weight loss and biomarker parameters in morbidly obese patients: A 12-month follow-up. *Obes Surg.* 2011;**21**(12):1834–42. doi: 10.1007/s11695-011-0525-8. [PubMed: 21964796]
40. Wittgrove AC, Clark GW, Tremblay LJ. Laparoscopic Gastric Bypass, Roux-en-Y: Preliminary Report of Five Cases. *Obes Surg.* 1994;**4**(4):353–7. doi: 10.1381/096089294765558331. [PubMed: 10742801]
41. de Csepel J, Nahouraii R, Gagner M. Laparoscopic gastric bypass as a reoperative bariatric surgery for failed open restrictive procedures. *Surg Endosc.* 2001;**15**(4):393–7. doi: 10.1007/s004640000347. [PubMed: 11395822]
42. Papasavas PK, Hayetian FD, Caushaj PF, Landreneau RJ, Maurer J, Keenan RJ, et al. Outcome analysis of laparoscopic Roux-en-Y gastric bypass for morbid obesity. The first 116 cases. *Surg Endosc.* 2002;**16**(12):1653–7. doi: 10.1007/s00464-002-8531-5. [PubMed: 12239643]
43. Biertho L, Steffen R, Ricklin T, Horber FF, Pomp A, Inabnet WB, et al. Laparoscopic gastric bypass versus laparoscopic adjustable gastric banding: a comparative study of 1,200 cases. *J Am Coll Surg.* 2003;**197**(4):536–44. doi: 10.1016/S1072-7515(03)00730-0. [PubMed: 14522318]
44. Nguyen NT, Slone JA, Nguyen XM, Hartman JS, Hoyt DB. A prospective randomized trial of laparoscopic gastric bypass versus laparoscopic adjustable gastric banding for the treatment of morbid obesity: Outcomes, quality of life, and costs. *Ann Surg.* 2009;**250**(4):631–41. doi: 10.1097/SLA.0b013e3181b92480. [PubMed: 19730234]
45. Angrisani L, Lorenzo M, Borrelli V. Laparoscopic adjustable gastric banding versus Roux-en-Y gastric bypass: 5-year results of a prospective randomized trial. *Surg Obes Relat Dis.* 2007;**3**(2):127–32. doi: 10.1016/j.soard.2006.12.005. [PubMed: 17331805]
46. Boza C, Gamboa C, Awruch D. Laparoscopic Rouxen-Y gastric bypass versus laparoscopic adjustable gastric banding: five years of follow-up. *Surg Obes Relat Dis.* 2010;**6**:470–5. [PubMed: 20702146]
47. Hutter MM, Schirmer BD, Jones DB. Laparoscopic Sleeve Gastrectomy has Morbidity and Effectiveness Positioned Between the Band and the Bypass. *Ann Surg.* 2011;**254**(3):410–22. doi: 10.1097/SLA.0b013e31822c9dac. [PubMed: 21865942]
48. Mason EE, Ito C. Gastric bypass in obesity. *Surg Clin North Am.* 1967;**47**(6):1345–51. [PubMed: 6073761]
49. Longitudinal Assessment of Bariatric Surgery C, Flum DR, Belle SH, King WC, Wahed AS, Berk P, et al. Perioperative safety in the longitudinal assessment of bariatric surgery. *N Engl J Med.* 2009;**361**(5):445–54. doi: 10.1056/NEJMoa0901836. [PubMed: 19641201]
50. Himpens J, Verbrugghe A, Cadiere GB, Everaerts W, Greve JW. Long-term results of laparoscopic Roux-en-Y Gastric bypass: evaluation after 9 years. *Obes Surg.* 2012;**22**(10):1586–93. doi: 10.1007/s11695-012-0707-z. [PubMed: 22865194]
51. Chapman AE, Kiroff G, Game P, Foster B, O'Brien P, Ham J, et al. Laparoscopic adjustable gastric banding in the treatment of obesity: A systematic literature review. *Surgery.* 2004;**135**(3):326–51. doi: 10.1016/S0039. [PubMed: 14976485]
52. Higa KD, Boone KB, Ho T, Davies OG. Laparoscopic Roux-en-Y gastric bypass for morbid obesity: Technique and preliminary results of our first 400 patients. *Arch Surg.* 2000;**135**(9):1029–33. [PubMed: 10982506]
53. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich J. Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg.* 2000;**232**(4):515–29. [PubMed: 10998650]
54. Podnos YD, Jimenez JC, Wilson SE, Stevens CM, Nguyen NT. Complications after laparoscopic gastric bypass: a review of 3464 cases. *Arch Surg.* 2003;**138**(9):957–61. doi: 10.1001/archsurg.138.9.957. [PubMed: 12963651]
55. Schauer P, Ikramuddin S, Hamad G, Gourash W. The learning curve for laparoscopic Roux-en-Y gastric bypass is 100 cases. *Surg Endosc.* 2003;**17**(2):212–5. doi: 10.1007/s00464-002-8857-z. [PubMed: 12457218]
56. DeMaria EJ, Sugerman HJ, Meador JG, Doty JM, Kellum JM, Wolfe L, et al. High failure rate after laparoscopic adjustable silicone gastric banding for treatment of morbid obesity. *Ann Surg.* 2001;**233**(6):809–18. [PubMed: 11371739]
57. Weber M, Muller MK, Bucher T, Wildi S, Dindo D, Horber F, et al. Laparoscopic gastric bypass is superior to laparoscopic gastric banding for treatment of morbid obesity. *Ann Surg.* 2004;**240**(6):975–82. [PubMed: 15570203]
58. O'Brien PE, McPhail T, Chaston TB, Dixon JB. Systematic review of medium-term weight loss after bariatric operations. *Obes Surg.* 2006;**16**(8):1032–40. doi: 10.1381/096089206778026316. [PubMed: 16901357]
59. O'Brien P. Is weight loss more successful after gastric bypass than gastric banding for obese patients? *Nat Clin Pract Gastroenterol Hepatol.* 2009;**6**(3):136–7. doi: 10.1038/ncpgasthep1363. [PubMed: 19204742]
60. Belachew M, Belva PH, Desaive C. Long-term results of laparoscopic adjustable gastric banding for the treatment of morbid obesity. *Obes Surg.* 2002;**12**(4):564–8. doi: 10.1381/096089202762252352. [PubMed: 12194552]