DOI: https://doi.org/10.25121/PNM.2018.31.2.76 Post N Med 2018; XXXI(2): 76-80

*Hady Razak Hady[1], Patrycja Pawluszewicz[1], Maria Soldatow[1], Jacek Dadan[1], Pawel Wojciak[1], Agnieszka Swidnicka-Siergiejko[2], Malgorzata Knas[3], Lukasz Szarpak[4], Adam Kretowski[5], Jerzy Robert Ladny[1, 6]

Analysis of the influence of laparoscopic adjustable gastric banding on BMI, carbohydrate and lipid metabolism in obese patients

Analiza wpływu laparoskopowej regulowanej opaski żołądkowej na BMI, gospodarkę węglowodanową i lipidową u otyłych pacjentów

[1]I[st] Department of General and Endocrine Surgery, University Clinical Hospital in Bialystok, Poland
[2]Department of Gastroenterology and Internal Medicine, University Clinical Hospital in Bialystok, Poland
[3]Department of Cosmetology, Lomza State University of Applied Sciences, Poland
[4]Lazarski University, Warsaw, Poland
[5]Department of Endocrinology, Diabetology and Internal Medicine, University Clinical Hospital in Bialystok, Poland
[6]Department of Emergency and Disaster Medicine, Medical University of Bialystok, Poland

Keywords
morbid obesity, LAGB, metabolic syndrome

Słowa kluczowe
otyłość olbrzymia, LAGB, zespół metaboliczny

Conflict of interest
Konflikt interesów
None
Brak konfliktu interesów

Address/adres:
*Hady Razak Hady
I Klinika Chirurgii Ogólnej
i Endokrynologicznej
Uniwersytecki Szpital Kliniczny
w Białymstoku
ul. M. Skłodowskiej-Curie 24A
15-276 Białystok
tel. +48 (85) 831-86-72
hadyrazakh@wp.pl

Summary

Introduction. Obesity is a serious health problem of modern medicine resulting from the disturbances of the proportion of energy supply and its expenditure, which is associated with the risk of developing many diseases and the increase in mortality. Bariatric surgery is the most effective way to reduce weight as well as prevent and treat obesity complications.

Aim. The aim of the study is to present the influence of laparoscopic adjustable gastric banding (LABG) on the parameters of carbohydrate and lipid metabolism, ALT, AST concentration and the effect on following co-morbidities such as diabetes type 2, hypertension and sleep apnea.

Material and methods. LABG has been applied in 31 men and 58 women with an average body weight of 123 ± 11.3 kg, BMI 43.20 ± 3.40 kg/m^2. In 6-month follow-up, weight loss and BMI were examined. Concentrations of insulin, glucose, ALT, AST, triglycerides, total cholesterol and its fractions HDL and LDL have been analyzed before surgery as well as 7 days, 1, 3 and 6 months after the surgery.

Results. After LABG was a statistically significant decrease in body weight and BMI as well as in insulin, totals cholesterol, LDL and triglycerides concentrations. There was a decrease in the incidence of co-morbidities such as type 2 diabetes, hypertension and sleep apnea.

Conclusions. LABG leads to effective weight loss, improvement of general health and normalization of metabolic parameters.

Streszczenie

Wstęp. Otyłość to poważny problem zdrowotny współczesnej medycyny wynikający z zachwiania proporcji podaży energii i jej wydatkowania, wiążący się z ryzykiem rozwoju wielu chorób oraz wzrostem śmiertelności. Chirurgia bariatryczna jest najskuteczniejszym sposobem obniżenia masy ciała oraz zapobiegania i leczenia powikłań otyłości.

Cel pracy. Celem pracy była ocena wpływu laparoskopowej opaski żołądkowej (LABG) na parametry gospodarki węglowodanowej i lipidowej, stężenie ALT, AST oraz wpływu na schorzenia współistniejące – cukrzycę typu 2, nadciśnienie tętnicze i zespół bezdechów sennych.

Materiał i metody. Operacji LABG poddano 31 mężczyzn oraz 58 kobiet o średniej masie ciała 123 ± 11,3 kg, BMI 43,20 ± 3,40 kg/m^2. W 6-miesięcznej obserwacji badano spadek masy ciała oraz BMI. Przeanalizowano stężenia insuliny, glukozy, ALT, AST, trójglicerydów, cholesterolu całkowitego oraz frakcji HDL i LDL przed operacją, 7 dni oraz 1, 3 i 6 miesięcy po zabiegu LABG.

Wyniki. Wykazano statystycznie istotny spadek masy ciała i BMI po zabiegu LABG oraz stężenia insuliny, cholesterolu całkowitego, LDL i trójglicerydów. Obserwowano spadek częstości występowania chorób towarzyszących – cukrzycy typu 2, nadciśnienia tętniczego i zespołu bezdechów sennych.

Wnioski. LABG prowadzi do skutecznej utraty masy ciała, poprawy ogólnego stanu zdrowia oraz normalizacji parametrów metabolicznych.

INTRODUCTION

Obesity is a serious problem of modern medicine. For many years there have been a growing percentage of people with excessive body mass, which allows discussion about a global epidemic of obesity (1, 2). Epidemiological data presented by the WHO shows that over 1.9 billion adults (18 years and above) were overweight in 2017, including over 650 million obese, which is respectively 39 and 13% (3). Obesity is caused by the predominance of energy supply over its expenditure, leading to excessive development of adipose tissue. The problem of obesity is not only the result of a disturbed lifestyle, especially eating habits, but also many other factors, and that is why it has to be resolved by many different methods, including conventional and surgical (4). Because conservative methods often are insufficient, the greatest attention of doctors daily meeting with obesity has focused on bariatric surgery, which in many centers was considered the treatment of choice for permanent weight reduction in obese patients who did not benefit from conservative treatment (5, 6).

Obesity is also a serious medical problem. It is associated with the occurrence of many diseases and increased mortality, patients with morbid obesity live on average 8-10 years shorter (7). The effects of diseases coexisting with obesity were observed by doctors of many specialties, who increasingly often have the greatest trust in bariatric surgery. Thus, effective treatment of obesity is not only the surgery itself, but pre- and post-operative multi-specialist care, the aim of which is to minimize the effects of type 2 diabetes, hypertension, cardiovascular diseases, sleep apnea, degeneration of joints, fatty liver, depressive disorders and gastrointestinal tumors.

The most common disorder associated with obesity is the metabolic syndrome. Depending on the agreed classification, it consists of individual risk factors predisposing to the development of CVD and T2DM. The WHO and ATP III criteria are most commonly used (8).

The growing problem of obesity is closely related to the widespread use of bariatric and metabolic surgery, as well as LAGB. Since 1994, LAGB has been one the most popular bariatric and metabolic procedures (9). However, depending on the region, the trend of its application varies. Specific discrepancies are observed when comparing North America with Europe (10, 11). In Poland, the first application of AGB was in 1998 and is currently one of the most commonly used bariatric techniques (12).

AIM

The aim of this study is to present the influence of laparoscopic gastric banding on insulin, glucose, triglycerides, total cholesterol and its fractions HDL and LDL, aspartate and alanine aminotransferase in obese patients and its influence on co-morbidities: T2DM, hypertension, sleep apnea.

MATERIAL AND METHODS

Between 2008 and 2014, 89 obese patients were hospitalized in the 1st Department of General and Endocrinological Surgery, who underwent a procedure for the laparoscopic adjustable gastric banding LABG. The distribution of gender and age, body mass and BMI of the operated patients has been analyzed. The patients underwent a 6-month follow-up during which the parameters of carbohydrate metabolism (insulin and glucose concentration as well as HOMA-IR index) and lipid parameters, as well as alanine and aspartate aminotransferase levels have been examined. The incidence of co-morbidities before and 6 months after the surgery has also been examined.

Statistical analysis was performed using Statistica 6.0 software for Windows. All values were given as mean ± SD. The Mann-Whitney test was used for examining the differences between preoperative and postoperative values. The value $p < 0.05$ was considered to be significant.

RESULTS

In a group of hospitalized obese patients were 31 men and 58 women. The mean body mass before surgery was 123 kg, and BMI 43.2 kg/m^2 (tab. 1).

Tab. 1. Characteristics of examined group (mean ± standard deviation)

Criteria	n = 89
Men/women [%]	31 (35%)/58 (65%)
Age men/women [years]	37/41
Body mass [kg]	123 ± 11.3
BMI [kg/m^2]	43.20 ± 3.40 kg/m^2

In the 6-month follow-up of patients after LABG, a gradual decrease in body weight and BMI has been observed. Decrease in insulin levels in the following months after the surgery has been observed. Glucose levels as well as HOMA-IR index showed no statistically significant change (tab. 2).

Tab. 2. Changes in insulin and glucose concentrations as well as in average BMI and HOMA-IR in 6-months follow-up after surgical treatment (mean ± standard deviation)

LAGB	Preoperative concentration	7 days	p	1 month	p	3 months	p	6 months	p
BMI (kg/m^2)	43.20 ± 3.28	40.60 ± 3.28	< 0.01	37.60 ± 3.49	< 0.01	33.60 ± 4.25	< 0.01	30.80 ± 5.30	< 0.01
Insulin (μU/L)	19.70 ± 5.65	15.50 ± 2.85	< 0.05	10.44 ± 4.9	< 0.05	9.51 ± 2.65	< 0.01	8.9 ± 0.72	< 0.01
Glucose (mg/dL)	102.92 ± 28.70	91.25 ± 10.11	NS	94.25 ± 6.2	NS	95.80 ± 5.83	NS	91.2 ± 1.6	NS
HOMA-IR	6.80 ± 1.30	3.83 ± 0.41	NS	3.9 ± 0.82	NS	3.51 ± 0.71	NS	3.64 ± 0.84	NS

Tab. 3. Changes in concentrations of total cholesterol and its fractions HDL and LDL as well as triglycerides in 6-months follow-up after surgical treatment (mean ± standard deviation)

LAGB	Preoperative concentration	7 days	p	1 month	p	3 months	p	6 months	p
Total cholesterol (mg/dL)	208.40 ± 13.5	184.2 ± 21.23	NS	176.68 ± 11.2	NS	171.20 ± 4.6	< 0.01	173.6 ± 7.32	< 0.01
HDL (mg/dL)	43.7 ± 8.85	31.32 ± 13.50	NS	33.94 ± 5.65	NS	38.20 ± 5.80	NS	44.94 ± 8.05	NS
LDL (mg/dL)	147 ± 19.5	136.5 ± 38.75	NS	133.85 ± 7.98	NS	126 ± 10.06	< 0.05	122.77 ± 3.25	< 0.05
Triglycerides (mg/dL)	134.45 ± 16.50	118.74 ± 25.10	NS	103.60 ± 11.88	NS	96.30 ± 12.80	< 0.05	83.5 ± 12.90	< 0.05

Tab. 4. Changes in concentration of alanine and aspartate aminotransferase in 6-months follow-up after surgical treatment (mean ± standard deviation)

LAGB	Preoperative concentration	7 days	p	1 month	p	3 months	p	6 months	p
AST (mg/dL)	44.10 ± 15.8	38.2 ± 18.92	NS	25.5 ± 7.1	NS	15.50 ± 6.8	NS	18.50 ± 3.88	NS
ALT (mg/dL)	39.50 ± 21.20	34.80 ± 16.30	NS	24.8 ± 12.80	NS	18.80 ± 11.25	NS	23.25 ± 11.65	NS

During observation of patients after LABG, the lipid metabolism has been studied. A statistically significant decrease in total and LDL-cholesterol and triglycerides levels has been observed. The concentration of HDL fraction did not change statistically significantly (tab. 3).

There were no significant changes in alanine and aspartate aminotransferase enzymes concentrations (tab. 4).

Type 2 diabetes was preoperatively diagnosed in 22 patients, hypertension in 35 patients, and sleep apnea in 11 patients. The improvement in type 2 diabetes occurred in 12 patients, in the case of hypertension in 23 patients an improvement has been observed. Symptoms of the sleep apnea have been resolved in 3 patients (tab. 5).

Tab. 5. Improvement of co-morbidities in patients after surgical treatment

	Before the surgery	6 months after the surgery	
	n	%	n
Type 2 diabetes	22	24.71	10
Hypertension	35	39.32	12
Sleep apnea syndrome	11	12.35	9

DISCUSSION

Obesity is a serious challenge for many areas of medicine, not only for bariatric surgery (13). The experience of our center also showed how serious the problem of obesity is. Fighting with it is not only a matter of one or another surgical technique, but also a proper pre- and post-operative approach. The role of patient is very important in the treatment process because the degree of cooperation and commitment depends largely on the results achieved. In our opinion, the skills and experience of the surgical team performing bariatric procedures have a significant impact on the results of treatment of obesity.

Obesity is a multifactor disease, therefore, specialists in many fields of medicine must be involved in the treatment of obese patients. In our opinion, the cooperation between surgeons and non-surgical specialties should be beneficial in achieving a mutual aim. These conclusions are also drawn by others specialists dealing with bariatrics (14).

All bariatric techniques lead to weight loss (15). After LAGB, most clinical and biochemical parameters are improved (16). In the case of LAGB, the observations presented in the literature are already extensive (17). Most of them present very favorable results for short-term observation. The most important treatment effects occur within the first two years of surgery (18), but LAGB is effective in weight loss even in long-term studies (19).

The effectiveness in weight loss results from close observation and post-operative control with regular adjustment of the band (20). The best effects after LAGB are obtained in 40-year-old patients with an initial BMI of 50 kg/m^2 (14). Our results are comparable to those described in the world literature (21, 22).

Diabetes has been a challenge for medicine for a long time. Bariatric surgery significantly reduces the symptoms or even leads to complete recovery in non-insulin-dependent diabetes mellitus in obese patients (23), the literature reports that LAGB leads to the recovery and/or improvement of T2DM in 66% and even in 96% of patients. The effectiveness of LAGB in pre-diabetic states is underlined (24). Nevertheless, the mechanisms of T2DM results remain poorly defined, and the impact of individual bariatric procedures on insulin resistance is unclear (25, 26). There were no significant differences in EWL between the group of diabetics and non-diabetics (27). Nevertheless, the majority of world literature unambiguously specifies

that the reduction of T2DM symptoms is closely related to % EWL after bariatric surgery, including LAGB. It has been proven that patients with T2DM remission had a greater % EWL than those who did not achieve such remission (28). Effects on T2DM results, including insulin resistance, have reduced caloric intake and weight loss (29). Available publications show a significant EWL (over 50%) and T2DM cure in 61% and hypertension in more than 40% of patients after LAGB (16). Among 8 diabetics operated on in our Department, in 4 an improvement have been observed, which is 50%.

Insulin resistance can be determined using the HOMA-IR factor. In a short-term study comparing 11 patients after LAGB and 104 after LRYGB, there was a reduction in HOMA-IR from 3.6 to 2.3 after an average follow-up of 162 days, with EWL 24.6% (30). The concentration of insulin and fasting glucose is used to determine HOMA-IR. Insulin in our patients during the entire 6-month follow-up statistically significantly decreased. Glucose, in turn, decreased from pre-operative level approx. 105 mg/dL, to ca. 93 after 6 months. The HOMA-IR coefficient was also reduced, with the reduction being most visible after 7 days.

Another important component of the metabolic syndrome is lipid metabolism, the parameters of which are also improved after LAGB, and the effect is noticeable up to 5 years after surgery (31). In our 6-month study, we obtained a reduction in total cholesterol and triglycerides levels.

After LAGB, an improvement in co-morbidities has been observed including arterial hypertension, depressive syndrome, arthrosis and sleep apnea (32, 33). The results of our center do not differ from the results described in world publications.

Based on our results and the literature available (34, 35) we come to the conclusion that the choice of the most commonly used bariatric techniques (LAGB, LRYGB and LSG) should take into account the safety and effectiveness of the chosen method individually and be supported by a multidisciplinary team.

CONCLUSIONS

LAGB as a minimally invasive procedure leads to a significant weight loss and it is recommended for patients under the age of 25. LAGB improves the patient's condition and normalizes metabolic parameters: insulin, glucose, HOMA-IR, total cholesterol, HDL, LDL and triglycerides. These results in a decrease in symptoms or complete recovery of metabolic and cardiovascular diseases, including: T2DM, hypertension and sleep apnea syndrome.

LAGB remains one of the most inexpensive bariatric procedures, easy to perform, with a short stay in the hospital and a satisfying effect. In order to obtain the best treatment results, patients after LAGB require close observation and adjustment of the band.

BIBLIOGRAPHY

1. Maggard MA, Shugarman LR, Suttorp M et al.: Meta-analysis: surgical treatment of obesity. Ann Intern Med 2005; 142: 547-559.
2. Hossain P, Kawar B, El Nahas M: Obesity and diabetes in the developing world – a growing challenge. N Engl J Med 2007; 356: 213-215.
3. WHO Fact sheet "Obesity and overweight" February 2018; http://www.who.int/mediacentre/factsheets/fs311/en/.
4. Hady RH, Zbucki RL, Luba ME et al.: Obesity as social disease and the influence of environmental factors on BMI in own material. Adv Clin Exp Med 2010; 19: 369-378.
5. Lau D, Douketis J, Morrison K et al.: 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children. CMAJ 2007; 176 (suppl. 8): 1-117.
6. Sjostrom L, Lindroos AK, Peltonen M et al.: Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med 2004; 351: 2683-2693.
7. Rosiek A, Frackowiak-Maciejewska N, Leksowski K et al.: Effect of Television on Obesity and Excess of Weight and Consequences of Health. Int J Environ Res Public Health 2015; 12(8): 9408-9426.
8. Grundy SM, Brewer HB, Cleeman JI et al.: Definition of metabolic syndrome: report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition. Circulation 2004; 109: 433-438.
9. Morino M, Toppino M, Garrone C et al.: Laparoscopic adjustable silicone gastric banding for the treatment of morbid obesity. Br J Surg 1994; 81: 1169-1170.
10. Buchwald H, Oien D: Metabolic/bariatric surgery worldwide 2008. Obes Surg 2009; 19: 1605-1611.
11. Hinojosa MW, Varela JE, Parikh D et al.: National trends in use and outcome of laparoscopic adjustable gastric banding. Surg Obes Relat Dis 2009; 5: 150-155.
12. Wylezol M, Pasnik K, Dabrowiecki S et al.: Polish recommendations for bariatric surgery. Videosurgery Miniinv 2009; 4 (suppl. 1): S5-S8.
13. Wickelgren I: Obesity: How Big a Problem? Science 1998; 280: 1364-1367.
14. Chevallier JM, Paita M, Rodde-Dunet MH et al.: Predictive factors of outcome after gastric banding: a nationwide survey on the role of center activity and patients' behavior. Ann Surg 2007; 246: 1034-1039.
15. Jastrzebska-Mierzynska M, Ostrowska L, Hady HR et al.: The impact of bariatric surgery on nutritional status of patients. Videosurgery Miniinv 2015; 10(1): 115-124.
16. Caiazzo R, Arnalsteen L, Pigeyre M et al.: Long-term metabolic outcome and quality of life after laparoscopic adjustable gastric banding in obese patients with type 2 diabetes mellitus or impaired fasting glucose. Br J Surg 2010; 97: 884-891.
17. Cunneen SA: Review of meta-analytic comparisons of bariatric surgery with a focus on laparoscopic adjustable gastric banding. Surg Obes Relat Dis 2008; 4 (3 suppl.): S47-55.
18. Sjöström L, Narbro K, Sjöström CD et al.: Effects of bariatric surgery on mortality in swedish obese subjects. N Engl J Med 2007; 357: 741-752.
19. Favretti F, Segato G, Ashton D et al.: Laparoscopic adjustable gastric banding in 1,791 consecutive obese patients: 12-year results. Obesity Surgery 2007; 17: 168-175.
20. Pournaras DJ, Osborne A, Hawkins SC et al.: Remission of Type 2 Diabetes After Gastric Bypass and Banding. Mechanisms and 2 Year Outcomes. Ann Surg 2010; 252: 966-971.
21. Ponce J, Paynter S, Fromm R: Laparoscopic adjustable gastric banding: 1,014 consecutive cases. J Am Coll Surg 2005; 201: 529-535.
22. de Jong JR, van Ramshorst B, Gooszen HG et al.: Weight loss after laparoscopic adjustable gastric banding is not caused by altered gastric emptying. Obes Surg 2009; 19: 287-292.
23. Dixon J, O'Brien PE, Playfair J et al.: Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. JAMA 2008; 299: 316-323.
24. Brancatisano A, Wahlroos S, Matthews S et al.: Gastric banding for the treatment of type 2 diabetes mellitus in morbidly obese. Surg Obes Relat Dis 2008; 4: 423-429.
25. Ballantyne GH, Wasielewski A, Saunders JK: The surgical treatment of type II diabetes mellitus: changes in HOMA Insulin Resistance in the first year following laparoscopic Roux-en-Y Gastric Bypass (LRYGB) and laparoscopic adjustable gastric banding (LAGB). Obes Surg 2009; 19: 1297-1303.
26. Raghow R: Bariatric surgery-mediated weight loss and its metabolic consequences for type-2 diabetes. Worlr J Diabetes 2013; 4(3): 47-50.

27. Singhal R, Kitchen M, Bridgwater S et al.: Metabolic outcomes of obese diabetic patients following laparoscopic adjustable gastric banding. Obes Surg 2008; 18: 1400-1405.
28. Polat F, Poyck PPC, Dickhoff C et al.: Outcome of 232 morbidly obese patients treated with laparoscopic adjustable gastric banding between 1995-2003. Dig Surg 2010; 27: 397-402.
29. Lee WJ, Lee YC, Ser KH et al.: Improvement of insulin resistance after obesity surgery: a comparison of gastric banding and bypass procedures. Obes Surg 2008; 18: 1119-1125.
30. Ballantyne GH, Wasielewski A, Saunders JK: The surgical treatment of type II diabetes mellitus: changes in HOMA Insulin Resistance in the first year following laparoscopic Roux-en-Y Gastric Bypass (LRYGB) and laparoscopic adjustable gastric banding (LAGB). Obes Surg 2009; 19: 1297-1303.
31. Spivak G, Sakran N, Dicker D et al.: Different effects of bariatric surgical procedures on dyslipidemia: a registry-based analysis. Surg Obes Relat Dis 2017; 13(7): 1189-1194.
32. Dalmar A, Singh M, Pandey B et al.: The Beneficial Effect of Weight Reduction on Adverse Cardiovascular Outcomes Following Bariatric Surgery is Attenuated in Patients with Obstructive Sleep Apnea. Sleep 2018; 41(5).
33. Ahroni JH, Montgomery KF, Watkins BM: Laparoscopic adjustable gastric banding: weight loss, co-morbidities, medication usage and quality of life at one year. Obes Surg 2005; 15(5): 641-647.
34. Padwal R, Klarenbach S, Wiebe N et al.: Bariatric surgery: a systematic review and network meta-analysis of randomized trials meta-analysis of randomized trials. Obes Rev 2011; 12(8): 602-621.
35. Michalik M, Lech P, Bobowicz M et al.: A 5-year experience with laparoscopic adjustable gastric banding-focus on outcomes, complications, and their management. Obes Surg Published online 27 May 2011.

received/otrzymano: 2.03.2018
accepted/zaakceptowano: 26.03.2018