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*Hady Razak Hady¹, Magdalena Luba¹, Mikołaj Czerniawski¹, Paweł Wojciak¹, Inna Diemieszczyk¹, Patrycja Pawluszewicz¹, Agnieszka Swidnicka-Siergiejko², Regina Sierzantowicz³, Marta Jastrzebska-Mierzynska⁴, Monika Jedynak⁵, Paulina Wozniowska¹, Jerzy Robert Ladny^{1,6}

Progress in bariatric-metabolic surgery

Postępy w chirurgii bariatryczno-metabolicznej

¹st Department of General and Endocrine Surgery, University Clinical Hospital in Białystok, Poland

²Department of Gastroenterology and Internal Medicine, University Clinical Hospital in Białystok, Poland

³Department of Health Sciences, Medical University of Białystok, Poland

⁴Department of Dietetics and Clinical Nutrition, Medical University in Białystok, Poland

⁵Department of Anesthesiology and Intensive Care, Medical University in Białystok, Poland

⁶Department of Emergency and Disaster Medicine, Medical University of Białystok, Poland

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Address/adres:

*Hady Razak Hady

I Klinika Chirurgii Ogólnej i Endokrynologicznej

Uniwersytecki Szpital Kliniczny

w Białymstoku

ul Skłodowskiej-Curie 24A

15-276 Białystok

tel. +48 605-683-455

hadyrazakh@wp.pl

BARIATRIC SURGERY WORLDWIDE AND IN POLAND

Bariatric-metabolic surgery in connection with world epidemic of obesity, its proven efficiency in treatment of this lesion and technological progress in the field of laparoscopy is recently one of the most developing field of surgery. Pursuant to the report of IFSO (International Federation for the Surgery of Obesity and Metabolic Diseases) presented in 2015, the number of bariatric procedures performed in 2013 exceed 460 000 cases worldwide including 154 000 procedures performed in the USA and Canada. Laparoscopic technique is a basis for surgical treatment of obesity, 95.7% of proce-

Summary

Bariatric-metabolic surgery has become one of the main surgical disciplines at the turn of the 20th and 21st century in connection with the obesity epidemic in the world, Europe and in Poland.

The beginning of the development of bariatric surgery in the 1950s occurred in the USA and Western Europe, and then rapidly spread throughout the world in the 1980s and 1990s. Currently, about 500,000 various bariatric and metabolic operations are performed, including more than 2,000 procedures in 15 bariatric centers in Poland.

Currently, bariatric and metabolic procedures are the most effective methods of treating obesity and co-morbidities, including the most dangerous diseases of the metabolic syndrome, type 2 diabetes and generalized atherosclerosis.

Streszczenie

W związku epidemią otyłości na świecie, w tym w Europie oraz Polsce, chirurgia bariatryczno-metaboliczna stała się jedną z głównych dyscyplin zabiegowych na przełomie XX i XXI wieku.

Początki rozwoju chirurgii bariatrycznej miały miejsce w USA oraz krajach Europy Zachodniej w latach 50. XX wieku. W latach 80. i 90. dziedzina ta szybko rozpowszechniła się na całym świecie. Obecnie rocznie na świecie wykonuje się ok. 500 000 różnorodnych operacji bariatryczno-metabolicznych, w tym ponad 2000 zabiegów w 15 ośrodkach bariatrycznych w Polsce.

Zabiegi bariatryczno-metaboliczne są najskuteczniejszą metodą leczenia otyłości i chorób jej towarzyszących, w tym najgroźniejszych chorób zespołu metabolicznego, takich jak: cukrzyca typu 2, nadciśnienie tętnicze i uogólniona miażdżyca.

cedures has been performed using this technique, while in 2013 the most frequently applied method was gastric bypass (45%), further, sleeve gastrectomy (37%) and gastric banding (10%). However, there are some differences in application of those procedures depending on the region of the world. In case of USA, Canada, Asia and region of Pacific Ocean, the most common procedure is SG, which is on the second position in Europe and South America after gastric bypass. It is worth mentioning that within last 10 years (2003-2013), since its first performance, sleeve gastrectomy is gaining popularity to the detriment of gastric banding (1).

It is estimated that currently in Poland, 2000 procedures is performed within the field of bariatric surgery

in 15 bariatric centers, mainly using 3 recommended methods: sleeve gastrectomy, gastric bypass (with the modification – mini gastric bypass) and gastric banding. The number is highly insufficient regarding 400 000 patients with morbid obesity.

REVIEW

The history of bariatric methods development

The beginning of bariatric surgery development is set in 1950s in connection with the observation of significant body mass loss in patients after gastrectomy or intestinal resection in treatment process of peptic ulcer disease or cancers, and adaptation of those procedures for the purposes of obtaining body mass reduction in obese patients. Proposed, at the time, restrictive procedures – initially jejunio-ileo bypass described by Kremen et al., procedures of anastomosis of small intestine with the transverse colon performed by Payne, de Wind and Scott caused significant body mass loss, however, according to superficially induced short intestine syndrome they led to unacceptable insufficiencies in vitamins absorption, deterioration of fats digestion or other complications which caused resignation from those methods (2-4).

In this period, the tendency was to apply more restrictive methods limiting the volume of the stomach which would not cause the disorders of absorption and their complications. Initially, horizontal sewing of the stomach has been applied (so called Pacey's and Carrey's gastropasty) but in face of the lack of long term effects in 1967 Mason and Ito proposed total horizontal cutting of the stomach connected with the anastomosis with intestinal loop which started the idea of one of the main contemporary methods joining the exclusion of the part of gastrointestinal tract and gastrointestinal restrictive-malabsorption (gastric bypass) (5). The technique of this procedure has been significantly modified by Griffen et al., who in 1977 introduced Roux-Y-en gastric bypass which prevent bile retrograde (6). The technique of modern gastric bypass underwent numerous modifications mainly in the part of length of nutritional and enzymatic loop and in laparoscopy it has been performed for the first time in 1993 by Wittgrove and Clark.

1980s brought innovative approach to bariatric surgery. In 1979 Scopinaro et al. proposed the procedure of biliopancreatic bypass performed until now, however, due to numerous postoperative complications and difficulties in performance of this type of procedure, very rarely (7). Aforementioned procedure has been further modified in 1993 by Marceau et al. and Hess and Hess by introducing the resection of the stomach in the area of greater curvature and replacement of gastro-ileal anastomosis with duodeno-ileal anastomosis calling the method biliopancreatic diversion duodenal switch (BPD-DS) which is performed until today (8, 9). In further years, active work on restrictive methods development have been conducted: in 1978 the method of unadjustable gastric banding has been introduced and

further replaced in 1986 with adjustable gastric banding. In 1980, Maisson, who has been considered as a pioneer of restrictive methods in bariatric surgery, performed, for the first time, horizontal gastropasty in which he joined horizontal resection of upper part of the stomach with implementation of polypropylene ring (10-12).

The idea of finding the method which could be efficient and simultaneously changing the physiology of gastrointestinal tract as little as possible found its reflection in "Magenstrasse and Mill" method proposed by Johnston in 1987 remaining modern sleeve gastrectomy with one difference: in the area of pylorus the opening has been performed using round stapler and the resection begun in this place along to the His's angle. LSG in modern form has been described for the first time in 1988 as a part of the procedure BPD-Ds. As an isolated procedure in open technique, it has been performed in 1993 and laparoscopically in 2000 by Ganger, and since then it gained popularity so it is respectively new method of surgical treatment of obesity (13).

In Poland, the pioneer of bariatric surgery is undoubtedly Pardela et al. who in the early 70's made the first gastrointestinal exclusion for the treatment of obesity and from 1993 in the center in Zabrze, he also performed vertical gastric banding (14, 15). The first laparoscopic surgery to treat obesity in Poland also has been performed in Zabrze in 1998 and included the insertion of a gastric band (16). For the first time gastric bypass surgery was performed in 1999 in classical technique and a year later laparoscopically. Sleeve gastrectomy performed from the beginning by laparoscopic technique was performed in Poland for the first time in 2003.

The first methods of bariatric surgery applied in Podlasie was Roux-y gastric bypass with the classical technique and laparoscopic adjustable gastric banding performed in the 1st Department of General and Endocrinological Surgery, Medical University of Białystok in May 2005 by Hady Razak Hady. Laparoscopic sleeve gastrectomy was performed for the first time in 2008 (17, 18).

Classification of bariatric-metabolic surgery methods

Since the beginning of bariatric surgery, the classification of surgical methods of obesity treatment has been based on the mechanism of action that currently in connection with intensive research on the effects of individual treatments, the increasing knowledge of the pathomechanism of obesity itself and innovative ideas of the treatments itself is more complicated than it was initially thought. According to the classification proposed earlier, bariatric surgery may be divided into: restrictive, malabsorptive and mixed. Currently, this division is considered obsolete and not practical, but useful for training purposes. Very often, a separate group is innovative experimental treatments. The choice of the proper type of surgery is an individual decision of

the surgeon and the patient due to the fact that the European Association for Endoscopic Surgery (EAES) so far has only developed guidelines that should be followed in the selection in the absence of a clear indication for a method identified as the appropriate one.

RESTRICTIVE MEASURES

Rely on reducing the volume of the stomach without altering the physiology of the gastrointestinal tract

A. VGB – VERTICAL BANDED GASTROPLASTY

Procedure for a long time considered the “golden standard” of bariatric treatment. Originally, the technique involved the creation of a “hole” in the two stomach walls with a diameter of 2.5 cm at a distance of about 5 cm from the Hiss angle and then from the “opening” to the top of the stitching calibrated on the 32F probe of the stomach with linear staplers. The treatment ended with the placement of a polypropylene mesh band (Marlex) around the narrowed part of the stomach. The most common complication was the creation of a channel connecting both parts of the stomach separated by the stapler and weight regaining (fig. 1, 2).

MacLean in 1993 introduced a modification to prevent this phenomenon in which, Rusing a cutting linear stapler, he led to a complete vertical separation of the digestive reservoir from the bottom of the stomach. The treatment in both techniques was also performed laparoscopically (LVBG) which significantly reduced the number of complications and mortality as well as improved the effectiveness of the procedure. % EWL in literature data after 1 year from LVBG ranged from 50 to 56.9% and after 4 years from 50.3 to 61% (19-21). This operation is currently very rarely performer, as suggested by the authors of the 10-year observation of the effects of this procedure – wrongly (22).

B. AGB – ADJUSTABLE GASTRIC BANDING

Bariatric surgery method which is the least invasive and completely reversible, although, its success largely depend on cooperation and proper control of the patient after surgery. The procedure consists of implementing a silicone ring in the area below cardia with a variable degree of restriction regulated by the port most often placed under the left rib arch and connected with a band by drain. The small reservoir of about 20-30 ml made above the band limits the amount of consumed food, causing an early feeling of fullness. At the beginning of the 21st century, it was the most frequently performed obesity treatment in the world, currently only 10% of treatments are performed in this way. The reason for the decline in popularity is the lack of metabolic effects of the surgery, unsatisfactory weight loss and a large number of complications particularly distant in the form of migration of the band to the stomach lumen, slipping the band or stomach rotation around the band (11) (fig. 3).

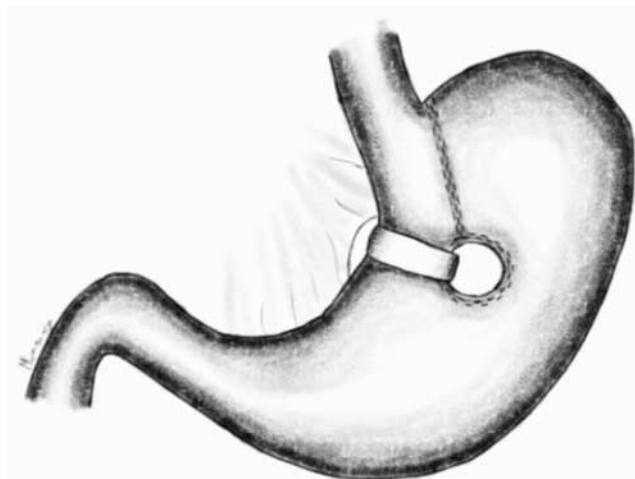


Fig. 1. Mason technique VGB (source: www.mp.pl)

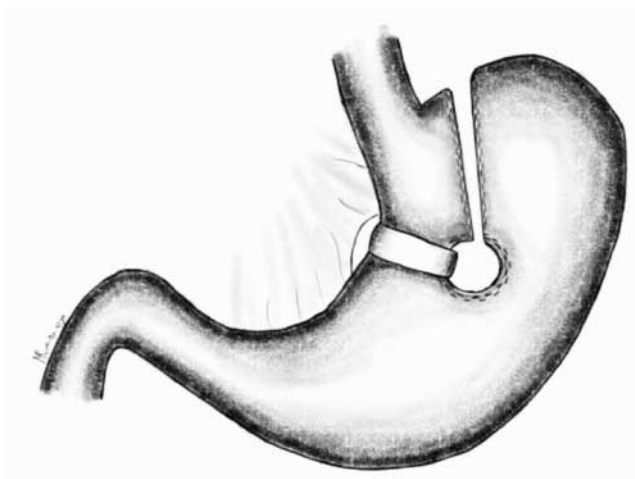


Fig. 2. MacLean technique VGB (source: www.mp.pl)

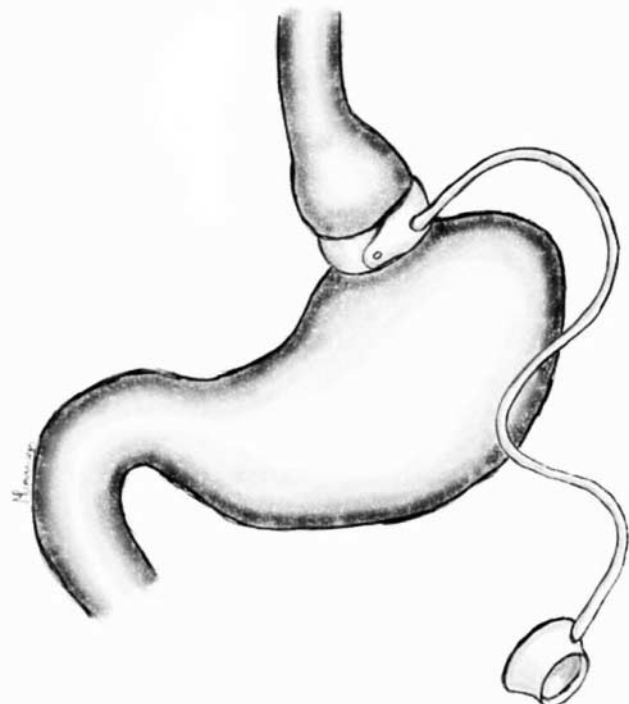


Fig. 3. Adjustable gastric band (source: www.mp.pl)

C. SG – SLEEVE GASTRECTOMY

The restrictive treatment, as shown by the latest research, also includes the component of neurohormonal changes resulting from the removal of the fundus. Initially recommended as the first stage of two-stage treatment in patients with super BMI > 50 kg/m², currently independent and isolated bariatric surgery with high effectiveness also in the treatment of metabolic complications. Sleeve gastrectomy is currently one of the most popular methods of bariatric surgery in the context of the described beneficial metabolic effects, lack of absorption disorders and a relatively “simple” surgical technique. The procedure is currently performed only in the laparoscopic technique. It consists of the resection of 2/3 of the stomach calibrated along the greater curvature using linear staplers after first dissecting the greater omentum. The new stomach is shaped like a narrow (tube-calibrated) tube. The diameter of the used tube depends on the surgeon and varies in different studies from 32 to 60F which may affect the result of the procedure. The resection starts 2-6 cm from the pylorus and ends at the angle of Hiss. Typically, LSG is performed using 5 ports but described modifications of the technique allow using only 3 ports, or LSGs it is also possible to use a single-port access. Linear staplers used during the procedure have different staple height (usually 3.5-4.5 mm) depending on the thickness of the stomach and the area of stapling (thinner wall of the fundus in comparison with the pyloric region) (13) (fig. 4).

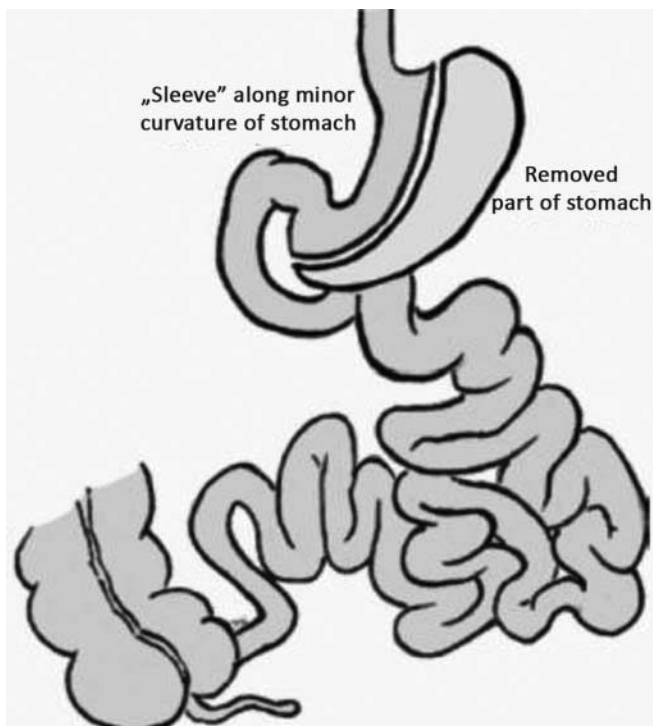


Fig. 4. Laparoscopic sleeve gastrectomy (LSG) (source: www.wp.pl)

D. LGCP – LAPAROSCOPIC GREATER CURVATURE PPLICATION

The restriction is achieved through the depression of the greater curvature to its interior, which reduces the volume of the stomach. Complications include swelling

of the double wall of the stomach or collection of fluid between the walls resulting in obstruction or gastric fistula.

MALABSORPTIVE PROCEDURES

The essence of the treatment is to exclude a large part of the gastrointestinal tract from absorption, while not containing any restrictive elements. Treatments are currently rarely performed due to the enormous malabsorption in the postoperative course. Actually, the only method is biliopancreatic diversion.

BPD – BILIOPANCREATIC DIVERSION – SCOPINARO METOD

The procedure consists of resection of 2/3 of the stomach and gastrointestinal anastomosis with the nutritional loop being maintained, 200-300 cm long. The ileo-ileal anastomosis is performed in this technique at a distance of 50-100 cm from the ileocecal valve. A treatment with very high efficacy, however, with high risk of perioperative and postoperative complications and causing large disturbances of absorption (fig. 5).

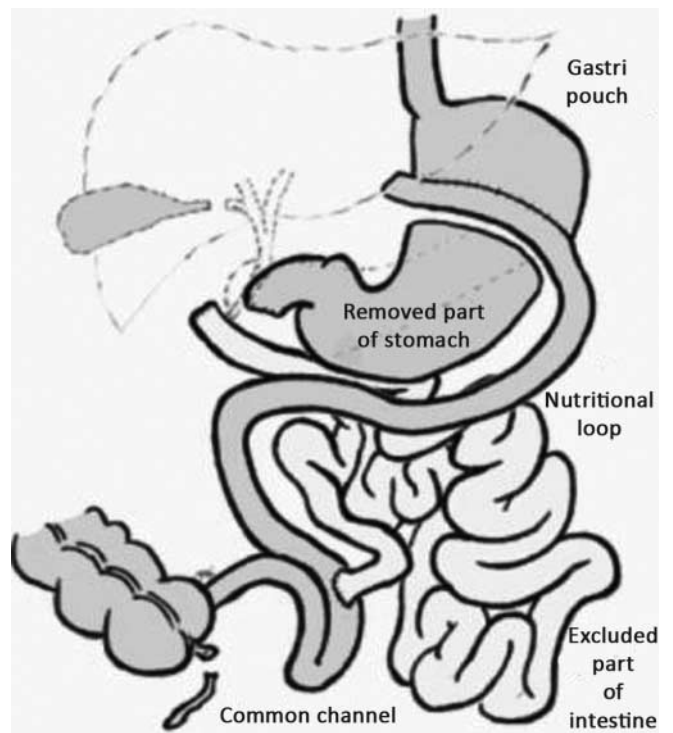


Fig. 5. Biliopancreatic diversion (source: www.mp.pl)

RESTRICTIVE – MALABSORPTION PROCEDURES

Treatments with a mixed mechanism of action combining the elements of restriction and exclusion of a part of the gastrointestinal tract

A. GB – GASTRIC BYPASS

A reversible operation with a mixed mechanism of action is particularly recommended for the treatment of metabolic syndrome. The technique is based on the production of a small stomach (gastric pouch) with a volume of approximately 50 ml, which is then joined

(gastrointestinal anastomosis) with an unseparated loop of the jejunum counting approximately 1 m from the Treiz ligament. The next step is the implementation of the intestinal anastomosis, isolating about 1.5 m of the intestine and finally the separation of the produced enzymatic loop (enzymatic limb) from the digestive loop (alimentary limb). The gastrointestinal exclusion is one of the main treatments performed currently and at the same time the method of the longest history and thus the long-term observation of the effects of the treatment. The beneficial metabolic effect in the form of glycemic normalization, improved lipid metabolism, and regression of co-morbidities are underlined from the very beginning. Among the complications that are characteristic for this treatment are internal fistulas, anastomotic fusion line, "dumping syndrome" or absorption disorders requiring supplementation of vitamins and microelements for the rest of patient life (13) (fig. 6).

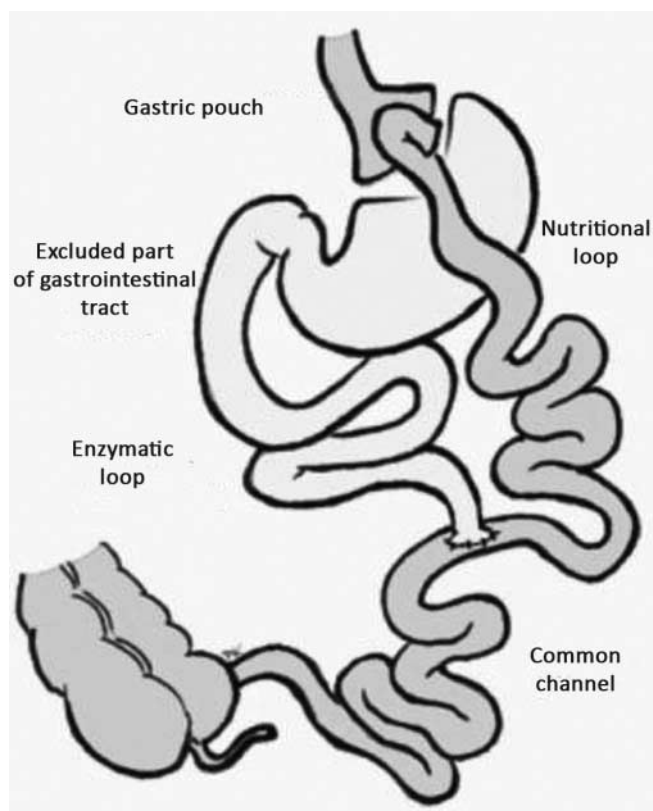


Fig. 6. Gastric bypass (source: www.mp.pl)

B. MINI GASTRIC BYPASS

The operation is also reversible, with an malabsorptive and restrictive nature as well as very beneficial metabolic effects. In the first stage, it consists of creating a gastric pouch similar in size to the one created in case of gastric bypass and then performing a loop intestinal anastomosis which, in the modified version, prevents the acid content of the stomach from being shed into the intestine. The treatment allows prediction of treatment effects by planning the length of the disabled loop. To achieve the optimal effect in a patient with a BMI of 40-50 kg/m² at the age of 35-50 years, it is recommended to exclude 200 cm of jejunum from the digestion and in the case of

BMI > 50 with each subsequent value higher by 5, 20 cm more should be excluded. For patients with BMI < 40 and at the age of > 55 it is recommended to exclude 20 cm of the intestine less and in people under 35, it is also necessary to exclude 20 cm of the intestine more (fig. 7, 8).

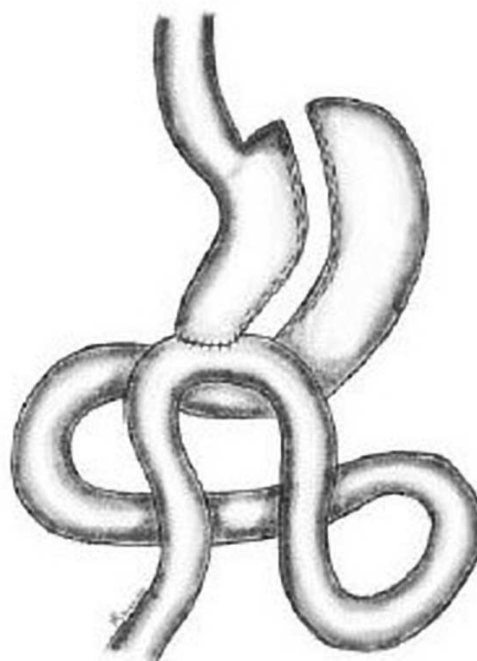


Fig. 7. Mini gastric bypass Rutledge technique (source: www.mp.pl)

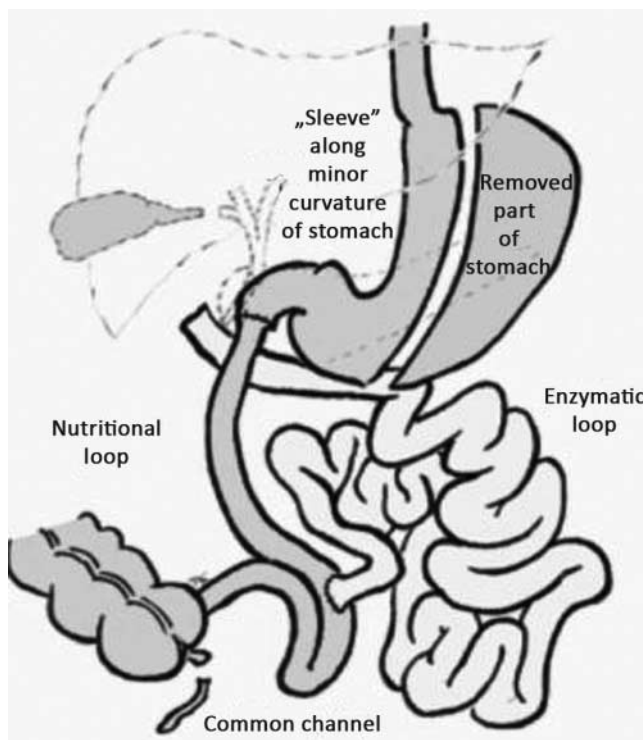


Fig. 8. Mini gastric bypass modified version (source: www.mp.pl)

C. BD-DS - BILIOPANCREATIC DIVERSION WITH DUODENAL SWITCH

A treatment consisting of a sleeve gastrectomy (restriction component) and duodenum-ileal and ileo-ileal anastomosis forming two Loos: nutritional and bilio-

pancreatic (disabling component). The advantages of the procedure are the preservation of the function of the dumping syndrome and the presence of part of the duodenum in the digestive tract. The exclusion of a large part of the small intestine from digestion, which is present in this technique, results in a very effective treatment of obesity, however, leads to deficiencies of vitamins and microelements or fatty diarrhea due to malabsorption. Although, the incidence of complications and mortality is lower than at BPD, surgery is rarely performed (7-9) (fig. 9)

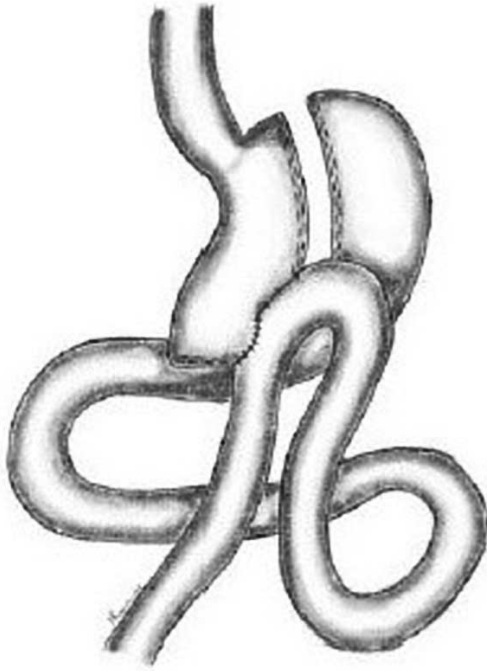


Fig. 9. Biliopancreatic diversion with duodenal switch (source: PancreasPictures.org)

D. SADI-S – SINGLE ANASTOMOSIS DUODENO-ILEAL BYPASS WITH SLEEVE GASTRECTOMY

A new surgical technique with only a few years of observation which is based on BPD-DS with the difference that there is one loop gastrointestinal anastomosis. Similarly to BPD-DS, a sleeve gastrectomy is performed. Failure to perform one anastomosis shortens procedure time and reduces the number of complications, and preliminary reports of 3 and 5-year follow-up confirm very promising results in the improvement of glucose and lipid metabolism (23, 24) (fig. 10).

Innovative treatments

At present, new methods are being sought which action would be directed not only at the loss of body weight but above all on the permanent improvement of metabolic disorders and, hence, effective treatment of type 2 diabetes.

A. Ileal interposition – the procedure described for the first time by Aureo De Paula consists of placing the intestinal fragment from the distal small intestine (a portion of ileum) into the area of the initial segment of the jejunum just behind the Treiz ligament (fig. 11).

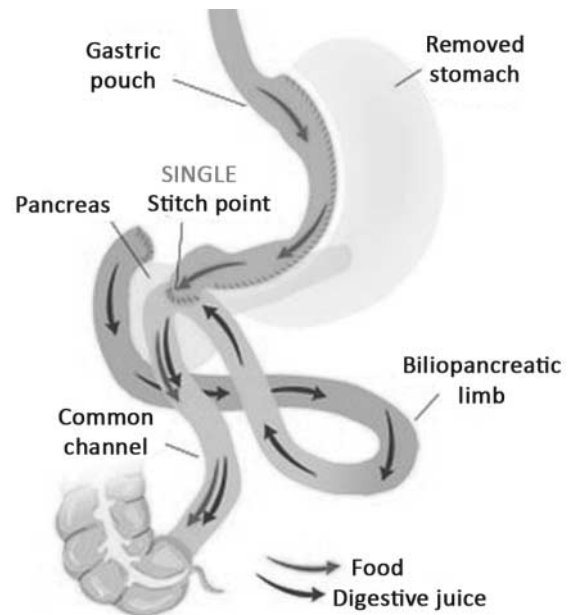


Fig. 10. Single anastomosis duodeno-ileal bypass with sleeve gastrectomy (source: longtermvsg.com)

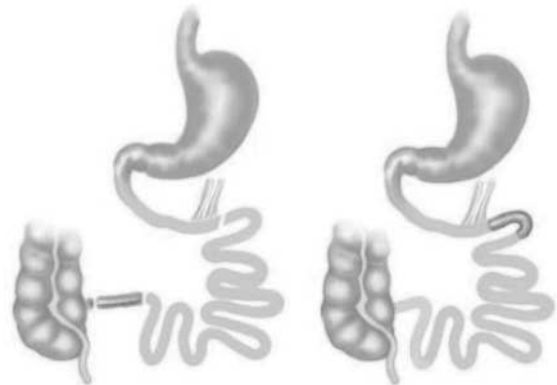


Fig. 11. Ileal interposition (source: healthproturkey.com)

B. Ileal Interposition in combination with sleeve gastrectomy (IISG),

C. Ileal Interposition in combination with diverted sleeve gastrectomy (IIDSG) – displacement of the distal fragment of small intestine into the proximal region performer along with sleeve gastrectomy (25, 26) (fig. 12, 13).

Both intestinal interposition procedures are performed mainly in Turkey. Currently, preliminary results of postoperative observations are only available. There is currently no acceptance of such procedures for the treatment of type 2 diabetes in Europe (27).

Gastrostimulation treatments

The idea of this type of treatment is to reduce the amount of intaken food by surgical insert of electrostimulation systems (e.g. vBlock®, Tantalus, Transcend II, ability® System) in the area of the vagus nerve or in the muscle tissue of the stomach. This method is free from complications typical for bariatric surgery, it is completely reversible and the effect of weight loss

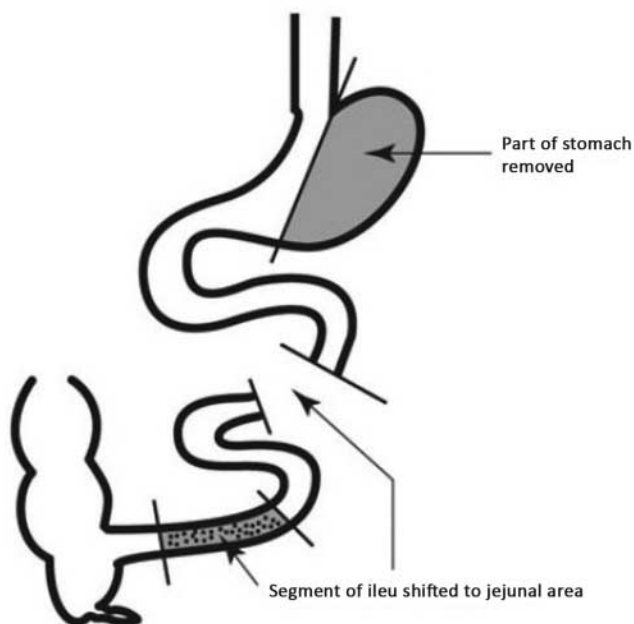


Fig. 12. IISG (source: 25)

and improvement of metabolic parameters is achieved by changing the gastric motility or by enhancing the transmission of the satiety signal to the CNS (28, 29).

CONCLUSIONS

Bariatric-metabolic surgery remains the most effective way to treat not only obesity but also its comorbidities, including the most dangerous diseases of the metabolic syndrome, such as type 2 diabetes, hypertension, heart disease, atherosclerosis, infertility in women and other.

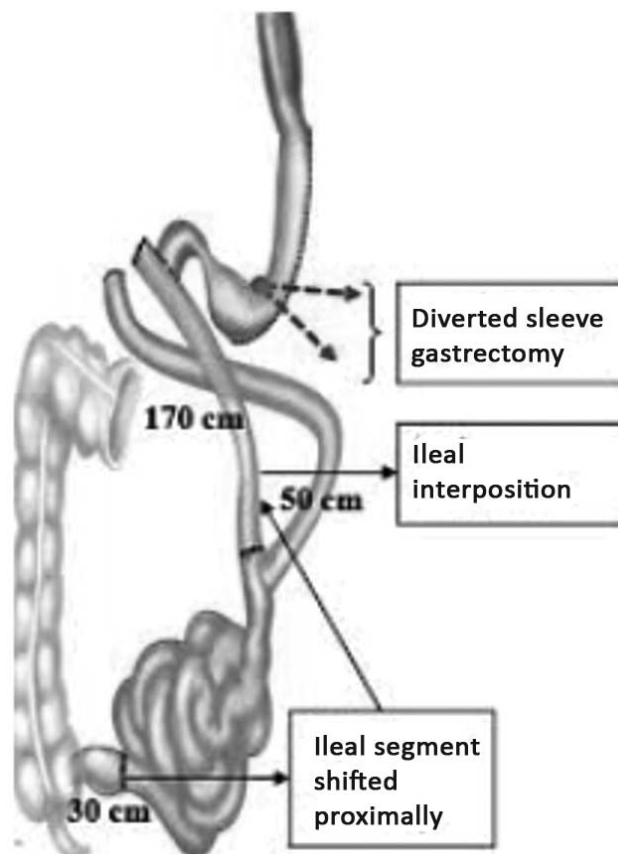


Fig. 13. IISGS (source: 27)

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