JERZAK, Aneta, JAKUBOWSKA, Katarzyna, JANOCHA, Aleksandra and ZIEMBA, Paweł. Various aspects of bariatric surgery - a review. Journal of Education, Health and Sport. 2024;74:52573. eISSN 2391-8306.
https://dx.doi.org/10.12775/JEHS.2024.74.52573
https://apcz.umk.pl/JEHS/article/view/52573

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 25.04.2024. Revised: 10.05.2024. Accepted: 17.06.2024. Published: 26.06.2024.

Various aspects of bariatric surgery - a review

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Abstract

Introduction and purpose

Obesity is a complex, chronic disease that has recently reached epidemic proportions. According to the World Health Organization, the prevalence of this disease tripled since 1975, reaching 13% of the global population in 2016. A body mass index (BMI) > 30 kg/m² is typically the reference point for obesity in adults, and the mortality risk associated with obesity increases by 100% at BMI > 40 kg/ m² compared to individuals with normal body weight. The aim of the article is to present the benefits of bariatric surgery, encompassing not only weight loss but also a range of other advantages for obese patients undergoing the procedure.

Materials and methods

The literature included in the PubMed databases is searched through the words such as obesity, bariatric surgery.

Description of the state of knowledge:

The literature review shows the breadth of the issue. Obesity constitutes a public health crisis and a significant risk factor for many diseases, including cardiovascular diseases, diabetes, cancer, and numerous others. Since in most cases, lifestyle optimization and low-calorie diet alone are not sufficient, pharmacological interventions as well as surgical interventions are often necessary. Bariatric surgery remains the most effective treatment option, as it has been demonstrated to not only reduce body weight but also decrease mortality from cardiovascular diseases and extend overall life expectancy.

Conclusions

The benefits, complications, and selection of the best surgical method for treating obesity are still under investigation. However, research demonstrates the long-term effectiveness of

bariatric surgery in weight loss and the remission of comorbidities such as type 2 diabetes, as well as in preventing obesity-related cancers.

Keywords
obesity, bariatric surgery, weight loss

1. Introduction

Obesity is a chronic, recurrent, and progressive disease, defined as the abnormal or excessive accumulation of fat, posing a health risk. [1,2] Over 650 million people worldwide suffer from obesity. Since 1980, the prevalence of obesity has doubled in over 70 countries. Moreover, the number of severe obesity cases is increasing, with estimates suggesting that by 2030, over half of the world's population will be overweight or obese. [1,3]

The remodeling of adipose tissue, involving angiogenesis, hypoxia, and inflammation, is associated with the development of obesity and metabolic changes. Metabolic complications include type 2 diabetes, steatosis, cardiovascular diseases, influenced by genetic factors as well as environmental factors such as intestinal microbiome. [4]

In the diagnosis of obesity, anthropometric indices are commonly used, such as waist circumference, waist-to-hip ratio, waist-to-height ratio, or body mass index (BMI). [5]

2. Objective of the work

The aim of the study is to describe the effects of bariatric surgery, including the effects on weight loss and improvement in anthropometric and metabolic parameters, as well as enhancing the quality of life for patients.

3. Description of the state of knowledge

The pathomechanism of obesity

The causes of obesity are multifaceted and include genetic, epigenetic, psychosocial, and microenvironmental factors. [2] Adipose tissue is distributed throughout the body and has a high capacity for expansion in cases of obesity. There are two main types of adipose tissue: white adipose tissue, which is predominant, and brown adipose tissue, comprising less than 5% of total fat in adults. White adipose tissue can be found in the abdominal cavity, subcutaneously, around major organs, and blood vessels. It stores excess energy in the form of triglycerides. In obesity, a low-grade inflammatory state is commonly observed. At the cellular level, macrophages infiltrate adipose tissue and contribute to both adipocyte hypertrophy and the release of pro-inflammatory cytokines. Adipose tissue is a metabolic and endocrine tissue known to release adipocytokines or adipokines, which are bioactive molecules such as fatty acids, adiponectin, leptin, and interleukin-6, influencing appetite regulation and energy homeostasis. [2,4,5,6]

The consequences of obesity

Obesity and resulting insulin resistance are the cause of the majority of cases of metabolic syndrome, which may double the risk of cardiovascular diseases and increase the risk of type 2 diabetes by about five times. [5] Complications related to obesity include musculoskeletal disorders, reproductive health issues, mental health problems, gastroesophageal reflux disease and kidney diseases. [1] In obesity, the metabolism of fatty acids in the liver undergoes changes, often leading to the accumulation of triglycerides in hepatocytes and to a clinical condition known as non-alcoholic fatty liver disease (NAFLD) and its progressive form, non-alcoholic steatohepatitis (NASH). These conditions largely contribute to chronic liver disease, ultimately leading to liver cirrhosis and hepatocellular carcinoma. Obesity also increases the risk of cardiovascular diseases (including diagnosed angina, myocardial infarction, heart failure, ischemic heart disease, and stroke). [1,6] Sleep-disordered breathing is very common in patients with complex and severe obesity, including obstructive sleep apnea and obesity hypoventilation syndrome. [3]

The diagnosis of obesity

Clinically severe obesity is commonly defined as a body mass index (BMI) ≥ 40 kg/m² or ≥ 35 kg/m² with obesity-related complications. The use of BMI has certain limitations as it overestimates obesity in individuals with significant lean body mass and does not provide information about the distribution of adipose tissue. [7] Other anthropometric measurements such as waist circumference, waist-to-hip ratio, and waist-to-height ratio indicate visceral obesity and thus serve as markers of increased cardiometabolic risk. However, standardization of these parameters may be technically challenging. [1,4]

Other tools assessing the distribution and quantity of adipose tissue include, among others, bioimpedance, dual-energy X-ray absorptiometry, quantitative magnetic resonance imaging, air-displacement plethysmography, and magnetic resonance imaging. [1]

More precise assessment tools have been developed not only to evaluate the severity of obesity but also to assess the risk of obesity-related complications and the impact of bariatric surgery interventions on the patient's condition. These are the King's Obesity Staging Criteria (KOSC), which categorize human health according to its physical, psychological, socio-economic, and functional status, as well as the Edmonton Obesity Staging System (EOSS), which is based on the medical, psychological, and functional impact of obesity. [8,9]

4. Medical literature review

OBESITY TREATMENT

Pharmacological treatment

Treatment for individuals with a BMI ranging from 25 to 26.9 kg/m² starts with a tailored dietary regimen, featuring a well-balanced Mediterranean diet devoid of excess calories, coupled with regular physical activity (at least 150 minutes per week). In cases where patients have a BMI of 27 kg/m² or higher with accompanying medical conditions, or a BMI of 30 kg/m² or higher, pharmacological intervention is advised as an additional measure. The objective is to attain a weight reduction of 5–10% within a span of 6 months. If the patient's BMI equals or exceeds 35 kg/m², a 20% decrease is aimed for. [10]

Interventions targeting lifestyle constitute the initial treatment for obesity. Nevertheless, even the most rigorous lifestyle modifications typically yield only a 5–10% reduction in weight, while sustaining weight over time remains challenging due to compensatory physiological mechanisms resulting in heightened appetite and decreased energy expenditure. [11]

Over the past few years, there has been swift advancement in pharmacotherapy for obesity and type 2 diabetes, focusing on gut hormones. Combinations of glucagon-like peptide 1 (GLP1) with other gut hormones like glucose-dependent insulinotropic polypeptide

(GIP), glucagon, and amylin are currently under examination as dual or triple therapies. These combinations aim to bolster and supplement the impact of GLP1 on complications related to weight loss and obesity. [11]

Surgical treatment

Following the 1991 guidelines set forth by the National Institutes of Health (NIH), eligibility for bariatric surgery requires a patient to have a BMI exceeding 40 kg/m² or exceeding 35 kg/m² alongside concurrent conditions like type 2 diabetes, hypertension, sleep apnea, and sleep-disordered breathing. The American Society for Metabolic and Bariatric Surgery (ASMBS) recommends that surgery be considered as an appropriate option for individuals with a BMI of 30–34.9 kg/m² and obesity-related comorbidities (especially diabetes) who have not achieved significant, sustained weight loss and improvement in comorbid conditions through other pharmacological methods. [10,12] Despite the literature indicating the effectiveness of bariatric surgery, less than 1% of eligible candidates worldwide undergo the procedure. [13]

Medical interventions used in the treatment of obesity can be divided into three groups: endoscopic procedures - useful in primary obesity treatment as well as in the management of surgical complications; restrictive surgical techniques involving reducing food intake volume; and mixed surgical techniques such as Roux-en-Y gastric bypass. [10]

The two commonly used procedures currently are laparoscopic Roux-en-Y gastric bypass (RYGB) and laparoscopic sleeve gastrectomy (SG), which constitute 75–80% of all procedures performed worldwide.[14] Both surgeries have been shown to result in weight loss of 50–70% of excess weight, equivalent to 12–17 BMI points. [15]

Roux-en-Y Gastric Bypass (RYGB)

The standard procedure involves creating a 20-30 ml gastric pouch using stapling techniques, followed by measuring 70-75 cm of jejunum from the ligament of Treitz and pulling it up to the newly formed antecolic ventricle. A gastrojejunostomy is then performed using a linear stapler, which is closed with absorbable sutures. Subsequently, 120-150 cm of jejunum is measured from the gastrojejunostomy, and an entero-entero anastomosis is performed with the feeding loop, after which the feeding loop is divided near the gastrojejunostomy using a linear stapler. [14,15,16] The formation of a small gastric pouch reduces food intake, and because of the bypassing of the pancreatic duodenum, which transports partially digested food to the lower intestine, there is reduced absorption of sugars and fats, thus enhancing glycemic control. [10]

Gastric sleeve

In gastric sleeve surgery, the greater curvature is exposed approximately 5 cm from the pylorus to the left crus of the diaphragm. Subsequently, the greater curvature is resected with a stapler calibrated along a thick gastric tube, French size 36, to transform the stomach into a tube. Approximately three-fourths of the stomach is removed. Unlike in gastric bypass surgery, intestinal continuity and continued access to the bile ducts are preserved. [15,16] This is a purely restrictive procedure, aiming to reduce calorie intake by patients and decrease appetite by removing cells that produce ghrelin (a protein hormone produced by cells in the fundus gastric, strongly affecting hunger sensations).[10]

Other less commonly used methods include intragastric balloon, endoscopic sleeve, endoluminal bypass, adjustable gastric band. [11]

THE EFFECTS OF BARIATRIC SURGERY

Weight loss

Gloy et. all conducted a meta-analysis of 11 randomized controlled trials to assess the quantitative overall effects of bariatric surgery compared to non-surgical treatment of obesity. Individuals qualified for surgery, compared to pharmacologically treated patients, exhibited greater weight loss (mean difference -26 kg), higher rates of remission of type 2 diabetes and metabolic syndrome, improved quality of life, reduced medication usage, and decreased serum triglyceride levels. In postoperative patients, high-density lipoprotein (HDL) levels increased more than in pharmacologically treated patients, while changes in blood pressure and values of total cholesterol and low-density lipoprotein (LDH) did not significantly differ between both groups. [17]

Colquitt et. all conducted a 2009 update of the Cochrane review, evaluating the impact of bariatric surgery on overweight and obesity treatment, as well as management of concurrent conditions. Their analysis encompassed twenty-two studies with 1798 participants, with the longest follow-up period spanning 10 years. The findings indicated that surgical interventions led to superior weight loss outcomes and management of associated diseases compared to non-surgical approaches, irrespective of the specific surgical procedures employed. Both RYGB and sleeve gastrectomy showed similar efficacy, outperforming adjustable gastric banding. Certain procedures exhibited greater effectiveness in weight loss and improvement of concurrent conditions than others. [18]

However, some studies such as that conducted by Grönroos et al., assessing weight loss equivalence between sleeve gastrectomy and laparoscopic RYGB after 7 years in patients with morbid obesity, demonstrated that laparoscopic Roux-en-Y gastric bypasses resulted in greater weight loss compared to sleeve gastrectomy, but the difference was not clinically significant based on pre-defined equivalence margins. [19]

Alqahtani et al. conducted a prospective cohort study analyzing the sustainability of weight loss and resolution of coexisting diseases, rate of growth, and adverse events associated with laparoscopic sleeve gastrectomy in children and adolescents with severe obesity. The patients' ages at the time of surgery ranged from 5 to 21 years, with 55% being female. The mean ± SD percentage of excess weight lost during short-term (1 to 3 years; n = 2051), medium-term (4 to 6 years; n = 1268), and long-term (7 to 10 years; n = 632) follow-up periods was 82.3% ± 20.5%, 76.3% ± 29.1%, and 71.1% ± 26.9%, respectively. The study authors confirmed the sustained weight loss following laparoscopic sleeve gastrectomy in children and adolescents.[20]

Diabetes and metabolic markers

The studies have shown that obesity is the strongest risk factor for the development of diabetes. [21]

Wu et al. conducted a meta-analysis aiming to compare the effects of bariatric surgery, new hypoglycemic medications (SGLT2 inhibitors, GLP1 receptor agonists, DPP4 inhibitors), and insulin in patients with type 2 diabetes (T2DM) and obesity. A total of 376 eligible randomized controlled trials were analyzed. Bariatric surgery was associated with significantly higher rates of achieving HbA1c < 7.0% compared to SGLT2 inhibitors, DPP4 inhibitors, insulin, and placebo/usual care, but did not significantly differ from GLP1 receptor agonists. Additionally, surgical treatment resulted in the greatest reduction in HbA1c (by approximately 1 percent) and body weight (by around 15 kg) after 12 months.[22]

Adams et al. presented the results of a 12-year prospective observational study in the United States regarding the outcomes of Roux-en-Y gastric bypass surgery. 1156 patients with severe obesity were divided into three groups: 418 patients who underwent the procedure (surgical group), 417 patients who sought surgery but did not undergo it (non-surgical group 1), and 321 patients who did not seek surgery (non-surgical group 2). Among patients in the surgical group who had type 2 diabetes at baseline, remission of type 2 diabetes occurred in 66 out of 88 patients (75%) at 2 years, 54 out of 87 patients (62%) at 6 years, and 43 out of 84 patients (51%) at 12 years. The study demonstrated the long-term sustainability of weight loss and effective remission and prevention of type 2 diabetes following Roux-en-Y gastric bypass surgery. [23]

Sansa et al. examined the correlations between baseline anthropometric parameters, metabolic parameters, resting energy expenditure, body composition, and annual percentage of excess body mass index loss in 103 obese women before and one year after laparoscopic Roux-en-Y gastric bypass surgery. After 1 year, the mean weight loss was 39.8 kg ± 11.7, and the levels of glucose, insulin, HDL cholesterol, LDL cholesterol, triglycerides, and CRP significantly decreased ($p < 0.001$). The authors confirmed that laparoscopic Roux-en-Y gastric bypass surgery has a beneficial impact on clinical, biological, and body composition parameters.[24]

Arterial hypertension and cardiovascular diseases

Being obese significantly contributes to numerous long-term health issues, among them hypertension, which amplifies the likelihood of cardiovascular conditions like heart disease and stroke. More than 40% of obese adults grapple with high blood pressure, a figure that escalates further among those with severe obesity. Arterial hypertension can be treated with antihypertensive medications, although significant weight loss can also lower blood pressure, reducing the need for antihypertensive drugs. [25] While antihypertensive drugs are generally safe and efficient, they do carry potential side effects like cough, dry mouth, frequent urination, heartburn and decreased sex drive, which can negatively impact one's quality of life. Adults who no longer rely on antihypertensive medications after surgery may consequently steer clear of these undesirable outcomes [26]

Junges et al. assessed the impact of Roux-en-Y gastric bypass surgery (RYGB) on both components of metabolic syndrome and the use of related medications in obese patients. The results showed a significant reduction in the use of antihypertensive drugs ($p <0.001$), anti-obesity drugs ($p = 0.010$), hypoglycemic agents ($p = 0.013$), and lipid-lowering medications ($p <0.001$) post-surgery. However, a considerable increase in the postoperative use of gastric protective drugs ($p < 0.001$), multivitamin and mineral supplements ($p < 0.001$), and iron alone ($p < 0.001$) was observed. [27]

The large meta-analysis of 39 prospective and retrospective cohort studies conducted by Veldhuisen and colleagues assessed the correlation between bariatric surgery and cardiovascular diseases. This systematic review and meta-analysis demonstrated that bariatric surgery is associated with reduced overall and cardiovascular mortality. Additionally, bariatric surgery was also linked to a decreased incidence of heart failure ($p < 0.001$), myocardial infarction ($p < 0.001$), and stroke ($p < 0.001$), while its association with atrial fibrillation was not statistically significant.[28]

Cancers

Obesity-related cancers account for 11.9% in men and 13.1% in women of all cancer diagnoses. The estimated risk of colorectal cancer associated with obesity shows a dose-response relationship, increasing by 24% in men and 9% in women with every 5 kg/m^2 increase in body mass index. [29]

Afshar et al. investigated the impact of Roux-en-Y gastric bypass surgery on biomarkers associated with the risk of colorectal cancer. Mucosal samples from the rectum and blood were collected from 22 patients undergoing surgery and 20 non-obese individuals in the control group at baseline and on average 6.5 months post-surgery. Systemic markers of inflammation and glucose homeostasis were assessed, along with the quantitative expression of pro-inflammatory genes and proto-oncogenes in the rectal mucosa, as well as the proliferative state of crypt cells in the rectal mucosa. The study findings demonstrated that Roux-en-Y gastric bypass surgery in obese adults led to reduced proliferation of rectal crypt cells, decreased systemic and mucosal markers of inflammation, and improved glucose regulation.[30]

In their retrospective cohort study, Feigelson et al. explored whether bariatric surgery correlates with a lower risk of breast cancer among women both pre- and post-menopause. They found that undergoing bariatric surgery is connected to a reduced likelihood of breast cancer in severely obese women. This finding has important implications for public health, particularly considering the ongoing increase in obesity rates and the scarcity of modifiable risk factors for breast cancer, especially in premenopausal women. [31]

A meta-analysis of 21 cohort studies conducted by Zhang et al., involving 304,516 surgically treated obese patients and 8.49 million non-surgically treated obese patients, revealed that bariatric surgery reduces the risk of cancer by 44% (odds ratio [OR] = 0.56, 95% confidence interval [CI] = 0.48 to 0.66). The meta-analysis indicated that bariatric surgery for severe obesity is associated with a decreased risk of cancer, both in terms of incidence and mortality.[32]

Others

Obese patients encounter obstacles when seeking transplantation and face distinctive hurdles during both preoperative and postoperative phases. Their obesity-related health conditions and advanced organ disease may hinder their referral for transplant evaluation, let alone placement on the transplant waitlist or actual transplantation.Grade 1 obesity (BMI 30-34.9 kg/m²) is typically not a contraindication, whereas grade 2 (BMI 35-39.9 kg/m²) and grade 3 obesity (BMI > 40 kg/m²) may be relative or absolute contraindications to transplantation. Sleeve gastrectomy and Roux-en-Y gastric bypass before transplantation of kidneys, liver, and thoracic organs have been shown to be safe and effective, as well as to increase access to the transplant waiting list and improve outcomes after transplantation. [33]

In their analysis of 18 studies on bariatric treatment, Sierżantowicz et al. affirmed that bariatric therapy provides lasting benefits in terms of health-related quality of life, particularly in its physical aspect. However, certain patients may derive lesser benefits in both quality of life and weight loss due to psychological factors. Early identification of these individuals and offering comprehensive care, including psychological support, could potentially enhance the effectiveness of bariatric treatment. [34]

5. Summary

Obesity is a chronic disease characterized by an excess of body fat, reaching epidemic proportions and posing a significant public health concern. As obesity rates continue to rise worldwide, new strategies to combat this disease are crucial in reducing morbidity and overall mortality associated with obesity-related complications. Over the past few decades, bariatric surgery has gained prominence in the treatment of morbid obesity and substantial reduction of comorbidities, mainly due to unsatisfactory outcomes of conventional clinical treatment. Bariatric surgery is associated with a decrease in the overall incidence of obesity-related cancers (hepatocellular carcinoma, colorectal cancer, pancreatic cancer, gallbladder cancer, breast cancer, and ovarian cancer), remission of diabetes and metabolic syndrome, reduction in the need for antihypertensive and lipid-lowering medications. Physical fitness and quality of life improve in patients after bariatric surgery.It is essential to remember that preoperative dietary assessment and biochemical monitoring are necessary to meet the nutritional needs of patients post-bariatric surgery and to identify and correct any nutritional deficiencies.

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All authors have read and agreed with the published version of the manuscript.
Funding: This research received no external funding. Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable.
Data Availability Statement: Not applicable.
Acknowledgments: Not applicable. Conflicts of Interest: The authors declare no conflict of interest.

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