Review paper

Erectile dysfunction in obese patients treated with bariatric surgery. A literature review

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Abstract

Recent statistics from studies around the world highlight a sharp increase in the number of patients struggling with obesity, who are more likely to signal difficulties in the sexual sphere. It is a major determinant of the occurrence of many pathologies, including sexual dysfunction in the population. Obesity in men leads to the occurrence of erectile dysfunction and reduced sexual desire, and thus a reduction in the frequency of intercourse. It can cause a number of endocrine disorders, resulting in a decrease in testosterone levels and the occurrence of sexual dysfunctions and an increase in certain pro-inflammatory cytokines. One of the most effective methods of invasive treatment of obesity is bariatric surgery. The aim of this paper is to review the literature related to erectile dysfunction in obese patients after bariatric surgery.

Introduction

Obesity is a condition that predisposes to the occurrence of numerous chronic diseases such as diabetes, hypertension and metabolic syndrome [1]. Statistical data emphasize the impact of morbid obesity on the number of premature deaths [2]. The Global Burden of Disease (GBD) 2015 Obesity Collaborators estimate that more than 603.7 million adults suffer from obesity. It has been shown that increased body mass index (BMI) values directly contributed to the death of over 4 million people in 2015 [3]. In North America, the prevalence of obesity was estimated at 41.90% in 2017–March 2020 in a nationally representative survey (National Health and Nutrition Examination Survey) [4].

Obesity reduces the overall quality of life of patients, considered in many aspects. When looking for determinants of a high sense of quality of life, sexual health and the level of satisfaction related to this dimension cannot be ignored [5]. Limited sexual activity and erectile dysfunction are common problems in obese men. The etiology of this problem may be multifaceted, both psychological and somatic. Men with high BMI are statistically more likely to have lower self-esteem, are critical in the assessment of their own body and attractiveness, and as a result, avoid engaging in sexual activity [6]. From a medical point of view, a high percentage of adipose tissue in the human body leads to general inflammation of the body, which in turn contributes to the failure of the cardiovascular system and impaired blood flow to the penis [7]. A large amount of adipose tissue stimulates the activity of aromatase, which metabolize testosterone, causing its significant decrease. The combination of all these factors may lead to sexual dysfunctions [8].

Bariatric surgery is a popular method of treating obesity. It contributes to long-term weight loss and reduces the symptoms of chronic comorbidities [9]. Scientific research has shown that this method significantly improves men's sexual performance compared to the conventional approach [10–12]. This literature review was based on the existing studies to assess the relationship between the bariatric surgery and male sexuality to contribute to the potential outlook on the choice of treatment in morbidly obese patients.

Aim of the research

The aim of this study was to review the literature on the subject that met the inclusion and exclusion criteria described in the PICO scheme related to erectile dysfunction in patients after bariatric surgery.

Methods

To address the topic of this paper, the literature on issues related to obesity, bariatric surgery, erectile dysfunction and the impact of obesity on male sex lives was reviewed. The following PICO scheme was applied.

Population

Inclusion criteria: adult male patients with class 3 obesity body mass index (BMI) > 40 kg/m^2 or class 2 obesity with a BMI of 35–39.9 kg/m^2, having undergone bariatric surgery and presenting sexual dysfunction in the form of erectile dysfunction as verified by the International Index of Erectile Function (IIEF).

Exclusion criteria: pediatric patients, female gender, BMI less than 35–39.9 kg/m^2, patients undergoing other non-surgical treatments for obesity, no presence of sexual dysfunction in the form of erectile dysfunction, were excluded from this analysis.

Intervention

Bariatric surgery to reduce the volume of the stomach used to treat obesity. Use of one of the surgical methods: Roux-en-Y gastric bypass, sleeve gastrectomy, adjustable gastric banding, laparoscopic gastric exclusion and laparoscopic sleeve gastrectomy.

Controls

Patients with obesity (BMI greater than 35–39.9 kg/m^2), following bariatric surgery without the presence of sexual dysfunction in the form of erectile dysfunction.

Outcome

To address the topic of this paper, the literature on issues related to obesity, bariatric surgery, erectile dysfunction and the impact of obesity on male sex lives was reviewed. A search of databases such as PubMed, Google Scholar, Medline, and EBSCO; papers published within the last 10 years were eligible. The search was conducted independently by two researchers. In case of any doubt, a review was performed again with a third researcher to minimize selection bias.

Both original and short communications were presented. The following English phrases were used: "bariatric surgery", "obesity", "erectile dysfunction", "impotence", "sex life", in combination with the AND and OR operators ("obesity" AND "bariatric surgery" AND "erectile dysfunction" OR "impotence" OR "bariatric surgery" AND "sex life").

43 full-text publications from 2014-2023 were included in the review according to the accepted PICO scheme. In addition, criteria for inclusion of publications in the review were: articles published in English, availability of an abstract and/or full-text version of the article. The exclusion criteria for the review were papers such as dissertations, commentaries, letters to the editor, books, published in a language other than English. The systematic review was visualized using the PRISMA flow diagram (Figure 1).

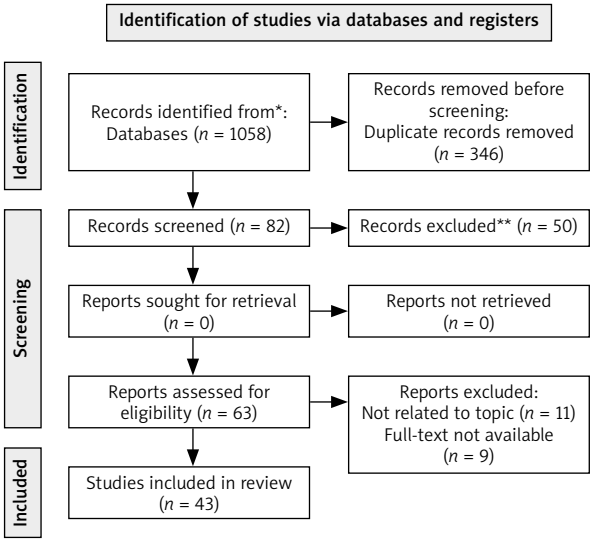

Figure 1. PRISMA flow diagram

Obesity and its effects related to the sexual life of men

The word 'obesity' comes from Latin and directly means 'one who has become plump through eating'. Scientific reports suggest that it first appeared in the writings of the English physician and medical writer Tobias Venner, whose words emphasized the impact of excessive body weight and the complications that occur on overall health [13].

The negative impact of obesity on human health and function has been known since ancient times. The records of Hippocrates, Galen and Avicenna all address the issues of excessive body weight on an individual's well-being [14]. Avicenna was one of the first to describe the link between obesity and male infertility in his medical book 'The Canon of Medicine' [15].

Obesity is defined as a condition of excessive pathological increase in body fat. The phenomenon of obesity and eating disorders has been subject to various interpretations over the years [16]. The World Health Organization (WHO) defines obesity as having a BMI above 30 kg/m^2, with the caveat that this definition is not universal for everyone [17].

Sexual dysfunction in obese people is the result not so much of the obesity itself, but of the complications it causes. The most common of these include type 2 diabetes, insulin resistance, hypertension and dyslipidemia [18]. The consequence of these diseases is a decrease in testosterone levels and an increase in pro-inflammatory cytokines. Clinical symptoms are manifested by decreased libido, frequency of sexual intercourse and erectile dysfunction [19].

Sexual mechanisms are characterized by a complexity of multiple mediating factors. They can be in-

fluenced by an individual's psychological well-being, physical and physiological factors. In men, statistically the most common problem is related to the arousal phase and the difficulty in obtaining and/or maintaining an erection [20, 21].

Erectile dysfunction associated with pathological obesity

Erectile dysfunction (ED) according to the accepted definition has been defined as the recurrent inability to achieve and/or maintain a penile erection sufficient for sexual satisfaction [22]. ED has a complex etiology that may be associated with both non-modifiable and modifiable factors, which often occur simultaneously [23]. Since 1992, the designation of these disorders with the word 'impotence' has been withdrawn due to the pejorative overtones and irreversibility of the problem [24]. As a large proportion of men with erectile dysfunction do not seek medical help, a clear determination of the extent of the problem is difficult [25].

Numerous endocrine abnormalities are diagnosed in obese men, resulting in pathological semen parameters, sexual dysfunction, infertility, psychological problems and disorders [26]. Androgens play a very important role in normal libido levels and the maintenance of full sexual function. Testosterone is important in regulating the expression of nitric oxide synthase (NOS) and PDE5 inside the penis [27]. Testosterone levels that are too low or hypogonadism play an important role in the mechanisms of ED pathogenesis; normal testosterone levels are crucial in achieving an erection [28].

Invasive treatment method for pathological obesity

With the rise in the number of obese populations, bariatric surgery has become the choice of invasive treatment to achieve and sustain weight-loss for longer-term compared to the non-invasive method of losing weight. This is particularly beneficial in men with obesity as the risk of ED increases with higher BMIs [29, 30]. The laparoscopic method of bariatric surgery has proven to be effective in treating hypogonadism in obese men, and the type of bariatric surgery did not have any significance on the end result [29, 31]. Reversal and/or improvement of the gonadal function is a crucial objective of undergoing bariatric surgery due to the prevalence of obesity-related hypogonadism in morbidly obese men.

The efficacy of bariatric surgery

Although the precise pathomechanism of erectile dysfunction requires further investigations to be elucidated, the efficacy of bariatric surgery on the erectile dysfunction has been congruent throughout the studies. The correlation between the increased number of adipose tissue and the decreased serum testosterone level has been a consistent finding in the studies measuring the effectiveness of bariatric surgery in morbidly obese men [31, 32]. It is suspected that the increased adipose tissues sustain the body in an inflammatory state which leads to decreased levels in serum testosterone. Moreover, the constant state of inflammation contributes to the deterioration of the endothelial wall of the vascular structure which leads to ED [33, 34].

Criteria for qualification for bariatric surgery vary globally; however, the general consensus is that surgery is indicated for patients with a BMI > 40 kg/m^2 or for those with a BMI of 35–40 kg/m^2 accompanied by obesity-related comorbidities. Within the reviewed studies various surgical methods including biliopancreatic diversion, sleeve gastrectomy and Roux-en-Y gastric by-pass (RYGP) have been performed, and the outcome indicated a positive trend in all elements that have been closely monitored [35, 36]. Other methods, including vertical banded gastroplasty and adjustable gastric banding have been recently removed from surgical options due to significant adverse effects, including gastro-esophageal reflux. Regarding the impact of specific surgical methods, there was no statistical significance found, however many studies suggest better long-term outcomes of combined methods (malabsorptive and restrictive) like gastric bypass when compared with purely restrictive operations like sleeve gastrectomy or adjustable gastric banding. The International Index of Erectile Function (IIEF) questionnaire and serum testosterone levels were commonly used as a measurement of effectiveness of bariatric surgery in morbidly obese men, and the postoperative results have been congruent [36, 37]. The majority of patients reported a satisfaction rate exceeding 90% in the postoperative IIEF questionnaire; however, the patient's psychological condition should be considered, as it may introduce bias in the questionnaire when evaluating the efficacy of bariatric surgery [38].

Furthermore, a recent meta-analysis demonstrated that an early improvement in serum testosterone levels is a consistent effect of bariatric surgery, indicating that surgical intervention may be more effective than non-invasive methods in the treatment of morbidly obese patients [33, 35, 38]. Interestingly, the level of nitric oxide showed a positive correlation with plasma testosterone levels, which may represent another potential factor influencing gonadal function in patients with ED. In a recent single-center study, Doppler ultrasound was used to assess penile vascularity and to measure differences in endothelial function before and after bariatric surgery [34]. As anticipated, all the corresponding patients have responded with significant improvements in both clinical and biochemical results in terms of the erectile function [34, 36].

Endothelial pathogenesis and bariatric surgery

Thus far, several theories have been considered regarding the main contributing factors on the pathogenesis of ED, and arteriogenic cause of the ED has been on the rise within recent years. Erection is achieved through vasodilation of the corpus cavernosum and the wall of small arteries of the penis. Nonetheless, the inability to relax of smooth muscles in the corpus cavernosum and the wall of small arteries prevents vasodilation leading to ED [39]. Moreover, it is indisputable that hypertension is one of the most common comorbidities found in the morbidly obese patients, and the gonadal vascular dysfunction cannot be disregarded.

The endothelial damage challenging the structural integrity to result in ED may be the consequence of increase in adipose tissue which causes the body to be in a constant inflammatory state [34, 40]. With the assistance of invasive treatment for pathological obesity, the artery flow-mediated vasodilation may be improved [39]. Furthermore, the individuals with successful maintenance of reduced BMI showed an increasing nitric oxide level with restored erectile function [33, 39].

Bariatric surgery and infertility

Despite the significant improvement in gonadal function due to bariatric surgery–induced weight loss, the probability of infertility remains unclear. Increase in the serum testosterone level has been observed relatively immediately after the surgical intervention with the erectile dysfunction being reversed; yet some continued to experience infertility [41]. This finding may raise further concerns and questions on the correlation between the structural defect and the sperm quality in morbidly obese patients. Furthermore, a team of researchers have highlighted the presence of secondary infertility and azoospermia in those who have gone through an invasive method to reduce their BMI [42].

Although sperm quality has a direct correlation with infertility, it is also linked with the age of the patient and the duration of the marriage, and the use of antihypertensive drugs can further contribute to the development of ED in morbidly obese patients [41, 43]. Thus, despite the superior outcome in BMI optimization and the increase in serum testosterone levels, along with increased nitric oxide levels as a result of bariatric surgery, its impact on sperm quality remains unclear. The Oxford Center for Evidence-Based Medicine (CEBM) criteria of 2011 were applied to evaluate the level of evidence in each literature, and the effects of bariatric surgery on erectile function, metabolic and hormonal profile are summarized in Table 1 [30].

The average postoperative time point review was around 6–12 months, and preoperative and postoperative IIEF scores, BMI, and serum testosterone level was measured. All patients who underwent bariatric surgery were male patients with class 2 and 3 obesity, and most reported mild-to-moderate ED with some severe ED [4]. A decrease of approximately 30% in postoperative BMI was observed, and statistically significant improvements in IIEF score (average $p < 0.001$) after bariatric surgery was found (Table 1). Moreover, patients with reduced BMI presented with an elevated total serum testosterone level and improved erectile function as early as 1 month post-operation, but the maximum result was seen around 6–12 months later.

Among several different types of bariatric surgery that was performed, sleeve gastrectomy (SG) was the most common type, however, the type of surgery did not have any significance on the result (Table 1). Most studies were non-randomized observations as the patients must consent to the invasive treatment with exception of cohort studies with randomized models for non-invasive treatments [33, 35, 37, 38]. The inverse correlation between BMI and the total serum testosterone level, and the linear relationship between the serum testosterone level and erectile dysfunction suggest that the excessive body weight may be the major risk factor of ED.

Discussion

In this literature review, we observed the superior BMI reduction in patients who underwent bariatric surgery with amelioration of erectile dysfunction compared to the conventional approach. Currently there is no consensus on the beneficial effects of the bariatric surgery on ED, however, congruent result of positive effects of the intervention on the total serum testosterone level was observed (Table 1). Although it is unclear whether only total serum testosterone or other hormones are involved in relation to ED, the evidence from our review suggests a strong correlation between the total serum testosterone level and ED. Moreover, it is necessary to conduct further research on arteriogenic factors on ED as hypertension is one of the most common comorbidities found in morbidly obese patients.

Our literature review had some limitations. A sample size discrepancy in some studies limited the validity of single-center observation with small sample sizes. Additionally, there were limited resources found within the same geographic locations that it is still unclear whether ethnic groups in different geographic regions have any influence on the result of bariatric surgery or not. Furthermore, the incongruent postoperative follow-up periods between studies, ranging from 1 month to 4 years, limited the validity of conclusions regarding the long-term benefits of invasive treatment for ED.

Table 1. Effects of bariatric surgery on erectile function, metabolic and hormonal profile [30]

Level of evidence	References/sample size	Intervention	Outcome
III	Aleid *et al.* [10]/30 patients	SG Gastric bypass Gastric banding	Follow-up period: 1, 3, and 6 months. Weight loss achieved: 20–25%. Outcome: Improvement in EF and intercourse satisfaction.
II	Sarwer *et al.* [11]/32 patients	Roux-en-Y Gastric bypass	Follow-up period: 1, 2, 3, and 4 years. Weight loss achieved: 29.4–33.3%. Outcome: Statistically significant increase in total testosterone ($p < 0.001$) and SHBG ($p < 0.001$); improvement in erectile function, overall satisfaction, and HRQoL.
II	Janik *et al.* [12]/152 patients	SG Roux-en-Y Gastric bypass	Follow-up period: 12–18 months. Weight loss achieved: NA. Outcome: Significant improvement in erectile function, sexual desire, and overall satisfaction.
II	Sarhan *et al.* [32]/48 patients	SG SAGB	Follow-up period: 12 months. Weight loss achieved: 31 ±7.4%. Outcome: Improvement in erectile function and total IIEF scores ($p < 0.001$); statistically significant improvement in serum testosterone levels ($p < 0.001$).
I	Małczak *et al.* [35]/508 patients	Roux-en-Y Gastric bypass SG Gastric banding BGB One-anastomosis gastric bypass Biliopancreatic diversion	Follow-up period: 6–48 months. Weight loss achieved: NA. Outcome: Improvement in erectile function; increased serum testosterone levels; and statistically significant improvement in IIEF scores ($p < 0.0001$).
II	Chen *et al.* [36]/59 patients	SG Roux-en-Y Gastric bypass	Follow-up period: 12–45 months. Weight loss achieved: 30.9%. Outcome: Significant improvement in serum testosterone levels ($p < 0.001$), FSH, LH, and total IIEF scores ($p < 0.001$).
I	Xu *et al.* [38]/420 patients	Gastric bypass	Follow-up period: 1 year. Weight loss achieved: Significant BMI reduction; exact percentage not reported. Outcome: Significant improvement in erectile function ($p < 0.00001$), total IIEF score ($p < 0.00001$), and total serum testosterone levels.
I	Liu *et al.* [33]/370 patients	Roux-en-Y Gastric bypass SG Gastric banding Lifestyle modifications	Follow-up period: 4 and 6 months; 1, 2, and 3 years. Weight loss achieved: BMI reduction; exact percentage not reported. Outcome: Improvement in erectile function, total IIEF score, and total serum testosterone levels.
III	Fahmy *et al.* [34]/82 patients	SG	Follow-up period: 12 months. Weight loss achieved: Mean weight loss of 34.8 kg. Outcome: Significant improvement in erectile function and IIEF scores ($p = 0.02$); increased nitric oxide synthase activity; decreased serum cholesterol and triglyceride levels.

Table 1. Cont.

Level of evidence	References/sample size	Intervention	Outcome
II	Rabjiewski *et al.* [37]/420 patients	Lifestyle modifications Bariatric surgery	Follow-up period: 6–24 months. Weight loss achieved: NA. Outcome: Significant increase in LH, FSH, total testosterone, and SHBG; improvement in erectile function.
III	El-Tholoth *et al.* [41]/42 patients	SG Roux-en-Y Gastric bypass	Follow-up period: 1 and 6 months; 1 year. Weight loss achieved: Mean BMI 30.4 ±5.5 kg/m². Outcome: Improvement in erectile function (p = 0.02) and IIEF score (76.7%).
II	Yacoubian and Nasr [43]/162 patients	SG Roux-en-Y Gastric bypass	Follow-up period: 6 months; 1 and 4 years. Weight loss achieved: NA. Outcome: Significant improvement in erectile function, SHBG, gonadotropins, and total serum testosterone levels.
II	Öncel *et al.* [43]/40 patients	SG	Follow-up period: 6 months. Weight loss achieved: Mean BMI 35.86 kg/m². Outcome: Improvement in erectile function and statistically significant improvement in IIEF-5 scores (p < 0.001).
III	Nosrati *et al.* [40]/81 total patients 41 male patients	SG Roux-en-Y Gastric bypass One-anastomosis gastric bypass	Follow-up period: 1, 3, 6, and 12 months. Weight loss achieved: BMI 30.88 ±2.88 kg/m². Outcome: Improvement in erectile function and IIEF score (p < 0.003).
III	Sultan *et al.* [30]/25 patients	Bariatric surgery –specific types NA	Follow-up period: 1, 3, and 6 months. Weight loss achieved: Mean BMI 33.6 kg/m². Outcome: Statistically significant improvement in erectile function and IIEF score (p < 0.001).

Level of evidence based on the Oxford Center for Evidence Based Medicine criteria of 2011. SG – sleeve gastrectomy, SAGB – single anastomosis gastric bypass, BGB – banded gastric bypass, EF – erectile function, SHBG – sex hormone binding globulin, HRQoL – health-related quality of life, NA – not available, NO – nitric oxide.

Bariatric surgery has been gaining popularity, and showing promising future for morbidly obese patients in terms of reducing and sustaining postoperative BMI with amelioration of ED. For future research, more investigations on arteriogenic factors of ED should be conducted as hypertension is one of the most common comorbidities in obese patients [29, 34, 40]. It is still unclear whether vascular wall integrity has a significant impact on ED, and whether arteriogenic ED can be salvaged with reduction of excessive body weight [29, 34, 40]. Although studies claim that the type of bariatric surgery does not correlate to the result, however, it is worth investigating the risk of infection for each type of bariatric surgery for it to become the choice of treatment in morbidly obese patients.

Conclusions

Obesity is a multifactorial disease which reduces the overall quality of life of patients. Limited sexual activity and erectile dysfunction have a negative impact on obese men, and bariatric surgery has been shown to improve men's sexual function following BMI reduction. Scientific research highlights the difference in erectile dysfunction before and after surgery, and bariatric surgery is one of the most effective methods of treating erectile dysfunction and hypogonadism. The literature review highlights the need of continuing research in this area.

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Ethical approval

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Conflict of interest

The authors declare no conflict of interest.

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