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ORIGINAL CONTRIBUTIONS

Early Effect of Metabolic Surgery on Erectile Function and Ejaculation: a Pilot Study of Obese Men with Type 2 Diabetes Mellitus

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Abstract

Purpose Majority of men with type 2 diabetes mellitus (T2DM) have been reported to experience erectile dysfunction (ED) in a lifetime. The aim of our study was to prospectively evaluate the postoperative condition of ED and premature ejaculation (PE) in men who underwent metabolic surgery for the treatment of T2DM.

Materials and Methods A total of 36 sexually active male individuals with T2DM who were applied for metabolic surgery were given two different questionnaire forms prior to and 6 months after the surgery. Patients filled the International Index of Erectile Function (IIEF) and the Premature Ejaculation Profile (*PEP*) questionnaires before and 6 months after the surgery. The BMI, fasting blood glucose (FBG), and glycated hemoglobin (HbA1c) concentrations were also measured prior to the surgery and on follow-up points of postoperative first, third, and sixth months.

Results Erectile function (EF) and overall satisfaction domains of the IIEF questionnaire increased significantly after the surgery in the patient groups irrespective of the previous ED severity ($p < 0.001$). There were significant improvements of the PEP interpersonal difficulty related to ejaculation score and HbA1c levels in the severe/moderate EF group and IIEF EF, PEP interpersonal difficulty related to ejaculation domains, and HbA1c levels of mild to moderate/mild/no ED group after the metabolic surgery.

Conclusion Metabolic surgery could improve erectile and ejaculatory function scores of obese patients with T2DM.

Keywords Metabolic surgery · Erectile dysfunction · Ejaculation profile · IIEF · Type 2 diabetes mellitus

Introduction

Obesity and type 2 diabetes mellitus (T2DM) are two worldwide epidemics that can impair the health and life quality of the affected individuals. Alongside the related adverse conditions and cardiovascular diseases, both obesity and T2DM are known as independent risk factors for erectile dysfunction (ED) through various mechanisms [1]. More than half of the men with T2DM have been reported to experience ED in a lifetime, and symptoms occur one or two decades earlier compared with the patients without metabolic conditions [2]. Studies suggest a bidirectional relationship between T2DM and ED, as obesity with T2DM is closely related to lower androgen levels, vascular endothelial factors, and proinflammatory cytokines in men with ED [3, 4]. On the other hand, low total and free testosterone and sex hormone-binding globulin (SHBG) levels were shown to be risk factors for insulin resistance, T2DM, and obesity, independent of age. The duration and severity of ED increase during the life course as the disease follows chronic progress [5].

Metabolic surgery is a recommended therapeutic tool in the management of T2DM and related conditions depending on the certain indications such as glycemic state, presence of obesity, and uncontrolled hyperglycemia [6]. Sleeve gastrectomy with transit bipartition (SG+TB) is a relatively novel metabolic surgery approach, establishing an opening into the ileum from the antrum of the stomach, and providing an additional passage for the food [7].

Weight loss and resolution of T2DM with the metabolic surgery methods have been shown to improve ED and related conditions such as premature ejaculation (PE), personal distress, and dissatisfaction [8]. Moreover, increased blood

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supply to the penis through endothelial nitric oxide (NO) synthase-related mechanisms and improvement of microvascular conditions after metabolic surgery have been shown in both experimental and clinical studies [9].

The aims of our study are to evaluate the presence of ED and PE in men who underwent SG+TB metabolic surgery for the improvement of T2DM and assess the postoperative follow-up measures of sexual performance using two independent scoring tools.

Materials and Methods

A total of 36 sexually active male individuals with T2DM who were applied for metabolic surgery with a BMI between 30 and 35 kg/m^2 with glycated hemoglobin (HbA1c) level of > 7.5% despite optimum anti-diabetic therapy, or a BMI greater than 35 kg/m^2 with a history of T2DM, and being obese for ≥ 5 years despite conservative weight loss therapy and lifestyle modifications were given two different questionnaire forms prior to and 6 months after the surgery.

The data were collected in accordance with the principles of the Declaration of Helsinki. The patients were informed about the possible complications and technical details of the surgery; written informed consent was obtained from each patient.

All patients were subjected to a thorough preoperative medical examination by a multidisciplinary team including a metabolic surgeon, endocrinologist, cardiologist, anesthesiologist, psychiatrist, ophthalmologist, urologist, and dietician. An intensive workup of blood and urine tests including tumor markers, lipid profile, and vitamin status, along with conventional preoperative workup, abdominal USG, chest X-ray, pulmonary examination and function testing, endoscopy of the upper GI tract, echocardiography, ECG, Doppler USG of the carotid and vertebral arteries, and ophthalmological and neurological examination along with psychiatric evaluation was performed for all of the patients prior to surgery.

The patients with hypertension, hyperprolactinemia, benign prostate hyperplasia, and any other neurologic, psychogenic, or cardiovascular condition that might affect erectile status have been excluded. The patients with a history of drug use or under treatment for ED and PE were also excluded.

Since the study was designed prospectively, the patients were given the International Index of Erectile Function (IIEF) and the Premature Ejaculation Profile (*PEP*) questionnaires and asked to fill the forms themselves in a close and intimate room designed for the study before the surgery and on the postoperative 6-month follow-up visit [10, 11].

The IIEF forms consisted of five domains including erectile function (30 points), orgasmic function (10 points), sexual desire (10 points), intercourse satisfaction (15 points), and overall satisfaction (10 points), and total scores were evaluated as 0–10 points severe ED, 11–16 moderate ED, 17–21 mild-moderate ED, 22–25 mild ED, and 26–30 no ED.

The intravaginal ejaculation latency time (IELT) was also questioned and the individuals were asked to estimate their values.

PEP score questionnaire included four different questions on control over ejaculation, personal distress related to ejaculation, satisfaction with sexual intercourse, and interpersonal difficulty related to ejaculation and each variable was scored a point between 0 and 4.

The BMI, fasting plasma glucose (FPG), and glycated hemoglobin (HbA1c) concentrations were also measured prior to the surgery and on follow-up points of postoperative first, third, and sixth months.

Statistical Analysis

Statistical analysis was performed using SPSS 22 for Windows (SPSS, Inc., Chicago, IL, USA).

Normal distribution was assessed using the Kolmogorov-Smirnov test. Since all data were outside the normal distribution, the Wilcoxon matched-pairs signed-rank test was employed for the comparison of pre- and postoperative variables. The comparison studies between severe/moderate EF and mild to moderate/mild/no ED groups were performed using an unpaired Mann-Whitney *U* test. Data were presented as median ± standard error of the mean (SEM), and minimum–maximum values per group. Statistical significance was defined as $p < 0.05$.

Results

EF and OS domains of the IIEF questionnaire increased significantly after the surgery in the patient groups irrespective of the previous ED severity ($p < 0.001$). There was no significant improvement in the other parameters of the IIEF and all parameters of the PEP questionnaires (Table 1).

When the patients were subgrouped according to EF status as severe and moderate EF and mild to moderate, mild, and no ES according to total IIEF scores, the EF, OF, IS, and OS domain scores were significantly different between two groups. The PEP scores indicating perceived control over ejaculation, personal distress related to ejaculation, satisfaction with sexual intercourse, and interpersonal difficulty related to ejaculation were also significantly different between the groups (Table 2).

The comparison of postoperative evaluation scores between the EF groups showed significant differences on the EF, OF, IS, and OS domain scores of the IIEF and PEP score parameters perceived control over ejaculation, personal distress related to ejaculation, and interpersonal difficulty related to ejaculation. The PEP variable satisfaction with sexual

Table 1 Comparison of pre- and postoperative IIEF and PEP scores

Variables	Preoperative	Postoperative	*p* value
IIEF EF domain	20 ± 1.7 (5–29)	24 ± 1.7 (5–29)	< 0.001
IIEF OF domain	8 ± 0.38 (4–10)	9 ± 0.4 (4–10)	0.125
IIEF SD domain	10 ± 0.31 (6–10)	10 ± 0.33 (6–10)	0.75
IIEF IS domain	8 ± 0.81 (0–12)	9.5 ± 0.93 (0–12)	0.078
IIEF OS domain	7 ± 0.57 (3–10)	9 ± 0.65 (3–10)	< 0.001
IELT preop dk	6 ± 1.48 (1–20)	6 ± 1.46 (1–20)	0.62
PEP perceived control over ejaculation	4 ± 0.45 (0–4)	4 ± 0.42 (0–4)	0.98
PEP personal distress related to ejaculation	4 ± 0.44 (0–4)	4 ± 0.43 (0–4)	0.99
PEP satisfaction with sexual intercourse	4 ± 0.4 (0–4)	4 ± 0.4 (0–4)	> 0.99
PEP interpersonal difficulty related to ejaculation	4 ± 0.21 (2–4)	4 ± 0.28 (1–4)	0.50

intercourse did not differ between the groups after the surgery (Table 3).

There were significant improvements of the PEP interpersonal difficulty related to ejaculation score and HbA1c levels in the severe/moderate EF group and IIEF EF, PEP interpersonal difficulty related to ejaculation domains, and HbA1c levels of mild to moderate/mild/no ED group after the metabolic surgery (Table 4).

The median age of participating individuals was 56.6 ± 3.71 in the severe and moderate EF groups and 49.50 ± 6.39 in the mild to moderate, mild, and no ES groups. Individuals in the severe and moderate EF groups were significantly older than the individuals in the mild to moderate, mild, and no ES groups ($p < 0.05$). Weight loss percentage at the end of the sixth month was significantly higher in the mild to moderate, mild, and no ES groups ($p < 0.05$). The baseline variables of the patients in the two groups are shown in Table 5.

Discussion

Obesity affects up to 40% of the male population in the USA as of 2020 [12]. Besides the cardiovascular risk factors affecting the life expectancy and quality, the majority of the cases with obesity and T2DM also suffer from ED. The abnormal or excessive fat accumulation in the body affects all vessels, resulting in atherosclerosis and narrowing of the vessel lumens; hence, endothelial dysfunction and decreased blood supply to the penis are among the organic causes of ED. Moreover, the severity of ED is correlated with the severity and duration of these conditions [13]. Although studies revealed the presence of ED in patients with obstructive sleep apnea, hypertension, and other obesity-related conditions, we excluded patients with these in order to provide a better understanding of the improvement in ED and present a more homogenous patient population. Metabolic surgery is a recent treatment of choice for the patients with T2DM and improvement of glycemic variables and lipid profile have been observed in various studies worldwide.

In our study, we observed that the mean EF and OS scores of IIEF significantly increased 6 months after the metabolic surgery. However, we did not observe a significant improvement in other variables of the IIEF questionnaire and all parameters of the PEP form. Despite the elevated IIEF OF and IS scores in the patient group following the surgery, the increase rate did not reach statistical significance. It should be of

Table 2 Baseline characteristics of severe and moderate EF group vs mild to moderate, mild, and no ED group

Variables	Severe and moderate EF	Mild to moderate and mild and no ED	*p* value
IIEF EF domain	9 ± 1.04 (5–10)	20 ± 1.06 (17–29)	< 0.0001
IIEF OF domain	7 ± 0.95 (4–8)	9 ± 0.27 (7–10)	< 0.01
IIEF SD domain	10 ± 0.4 (8–10)	10 ± 0.4 (6–10)	0.78
IIEF IS domain	3 ± 0.8 (0–5)	9 ± 0.47 (6–12)	< 0.0001
IIEF OS domain	3.5 ± 0.28 (3–4)	8 ± 0.43 (5–10)	< 0.0001
IELT preop dk	2 ± 3.25 (2–15)	6 ± 1.69 (1–20)	0.34
PEP perceived control over ejaculation	0.5 ± 0.94 (0–4)	4 ± 0.48 (0–4)	< 0.01
PEP personal distress related to ejaculation	0.5 ± 0.94 (0–4)	4 ± 0.45 (0–4)	< 0.05
PEP satisfaction with sexual intercourse	1 ± 0.75 (0–3)	4 ± 0.42 (0–4)	< 0.01
PEP interpersonal difficulty related to ejaculation	2.5 ± 0.47 (2–4)	4 ± 0.21 (2–4)	< 0.05

Table 3 Postoperative characteristics of severe and moderate EF group vs mild to moderate, mild, and no ED group

Variables	Severe and moderate EF	Mild to moderate and mild and no ED	*p* value
IIEF EF domain	9 ± 1.04 (5–10)	25 ± 0.73 (20–29)	< 0.0001
IIEF OF domain	7 ± 0.95 (4–8)	9 ± 0.25 (7–10)	< 0.01
IIEF SD domain	10 ± 0.4 (8–10)	10 ± 0.41 (6–10)	0.91
IIEF IS domain	3 ± 0.8 (0–5)	11 ± 0.56 (6–12)	< 0.0001
IIEF OS domain	3.5 ± 0.28 (3–4)	10 ± 0.18 (8–10)	< 0.0001
IELT preop dk	2 ± 3.25 (2–15)	6 ± 1.66 (1–20)	0.26
PEP perceived control over ejaculation	0.5 ± 0.94 (0–4)	4 ± 0.41 (0–4)	< 0.01
PEP personal distress related to ejaculation	1 ± 0.75 (0–3)	4 ± 0.42 (0–4)	< 0.05
PEP satisfaction with sexual intercourse	2 ± 0.62 (1–3)	4 ± 0.29 (1–4)	0.08
PEP interpersonal difficulty related to ejaculation	9 ± 1.04 (5–10)	25 ± 0.73 (20–29)	< 0.0001

concern that the mean age of the study population was 51.5 in our study group, and while we subgrouped individuals into severe/moderate EF and mild to moderate/mild/no ED groups, there was a significant difference in terms of age between the groups. Thus, the lower IIEF EF, OF, IS, OS, and PEP domains perceived control over ejaculation, personal distress related to ejaculation, and interpersonal difficulty related to ejaculation in the severe/moderate ED group might be a consequence of the age and longer duration of chronic disease T2DM and obesity.

In a statement by the American Diabetes Association (ADA), low testosterone levels and sexual dysfunction are common findings in patients with obesity, metabolic syndrome, and T2DM. The relationship between obesity and

Table 4 Baseline and postoperative characteristics of the groups

Variables	Preoperative	Postoperative	*p* value
Severe and moderate EF			
IIEF EF domain	9 ± 1.04 (5–10)	9 ± 1.04 (5–10)	0.87
IIEF OF domain	7 ± 0.95 (4–8)	7 ± 0.95 (4–8)	1.00
IIEF SD domain	10 ± 0.4 (8–10)	10 ± 0.4 (8–10)	1.00
IIEF IS domain	3 ± 0.8 (0–5)	3 ± 0.8 (0–5)	1.00
IIEF OS domain	3.5 ± 0.28 (3–4)	3.5 ± 0.28 (3–4)	1.00
IELT preop dk	2 ± 3.25 (2–15)	2 ± 3.25 (2–15)	1.00
PEP perceived control over ejaculation	0.5 ± 0.94 (0–4)	0.5 ± 0.94 (0–4)	1.00
PEP personal distress related to ejaculation	0.5 ± 0.94 (0–4)	1 ± 0.75 (0–3)	0.78
PEP satisfaction with sexual intercourse	1 ± 0.75 (0–3)	2 ± 0.62 (1–3)	0.66
PEP interpersonal difficulty related to ejaculation	2.5 ± 0.47 (2–4)	9 ± 1.04 (5–10)	< 0.01
HbA1c	9.28 ± 0.59 (8.7–10.2)	6.26 ± 1.25 (5.4–7.7)	< 0.001
Mild to moderate and mild and no ED			
IIEF EF domain	20 ± 1.06 (17–29)	25 ± 0.73 (20–29)	< 0.05
IIEF OF domain	9 ± 0.27 (7–10)	9 ± 0.25 (7–10)	0.96
IIEF SD domain	10 ± 0.4 (6–10)	10 ± 0.41 (6–10)	0.98
IIEF IS domain	9 ± 0.47 (6–12)	11 ± 0.56 (6–12)	0.48
IIEF OS domain	8 ± 0.43 (5–10)	10 ± 0.18 (8–10)	0.52
IELT preop dk	6 ± 1.69 (1–20)	6 ± 1.66 (1–20)	0.96
PEP perceived control over ejaculation	4 ± 0.48 (0–4)	4 ± 0.41 (0–4)	0.92
PEP personal distress related to ejaculation	4 ± 0.45 (0–4)	4 ± 0.42 (0–4)	0.94
PEP satisfaction with sexual intercourse	4 ± 0.42 (0–4)	4 ± 0.29 (1–4)	0.96
PEP interpersonal difficulty related to ejaculation	4 ± 0.21 (2–4)	25 ± 0.73 (20–29)	< 0.0001
HbA1c	8.12 ± 1.61 (5.3–10.7)	5.85 ± 1.33 (4.3–8.17)	< 0.001

Table 5 Baseline and postoperative characteristics of severe and moderate EF group vs mild to moderate, mild, and no ED group

Variables	Severe and moderate EF	Mild to moderate and mild and no ED	*p* value
Age	56.6 ± 3.71 (52–62)	49.50 ± 6.39 (39–64)	< 0.05
BMI	34.2 ± 2.68 (28.7–40.35)	32.82 ± 3.12 (27.0–44.18)	0.77
HbA1c	9.28 ± 0.59 (8.7–10.2)	8.12 ± 1.61 (5.3–10.7)	0.14
Insulin	20.31 ± 4.17 (12.17–26.6)	11.38 ± 2.27 (7.38–30)	0.15
C peptide	2.49 ± 0.56 (1.92–3.27)	3.04 ± 1.05 (1.07–4.39)	0.34
HOMA-IR	9.42 ± 3.26 (5.5–13.45)	7.22 ± 3.72 (3.43–15.66)	0.32
Operative time (min)	164.0 ± 22.19 (135–190)	177.9 ± 35.29 (135–235)	0.42
HbA1c (postoperative 1st month)	7.75 ± 0.76 (6.9–8.4)	7.56 ± 1.27 (5.9–9.6)	0.78
Weight loss %(postoperative 1st month)	12.4 ± 2.68 (10–16.8)	14.11 ± 3.03 (10.6–20)	0.31
HbA1c (postoperative 3rd month)	6.49 ± 0.69 (5.7–7.28)	6.04 ± 1.41 (4.7–8.61)	0.57
Weight loss % (postoperative 3rd month)	18.91 ± 7.391 (8.00–24.3)	21.24 ± 3.19 (17.2–27.5)	0.42
HbA1c (postoperative 6th month)	6.26 ± 1.25 (5.4–7.7)	5.85 ± 1.33 (4.3–8.17)	0.66
Weight loss % (postoperative 6th month)	11.89 ± 7.06 (7.05–20.0)	24.85 ± 6.29 (14.7–30.4)	< 0.05

low testosterone levels is multidirectional and affects multiple endocrine and metabolic pathways [5]. Low levels of total and free testosterone and sex hormone-binding globulin (SHBG), the carrier protein of testosterone, were shown to be closely associated with an increased risk of developing metabolic syndrome and T2DM, independent of age, race, and obesity [14, 15]. Furthermore, antigen-binding medications for the treatment of prostate cancer resulted in an increased incidence of T2DM in older men [4]. The suggested pathogenesis of obesity and T2DM in the low testosterone and/or SHBG levels environment has focused on that steroid hormones modulate response to insulin via proinflammatory mediators [16, 17]. On the other hand, adipose tissue contains the aromatase, the enzyme that converts testosterone to estradiol, and elevated estrogen and decreased testosterone levels are well-known causes of ED [18].

In a study of 30 men who underwent bariatric surgery, erectile function and intercourse satisfaction domains significantly improved starting at postoperative 1 month [19]. Similarly, we found increased EF scores in our patients in the mild to moderate/mild/no ED group, of which the mean age was significantly younger than the severe/moderate EF group. Noteworthy is that, our study groups were not adjusted for age; hence, different outcomes would be expected in a younger age group with moderate or severe ED.

Although there was a significant difference in the variables IIEF EF, OF, IS, OS and PEP domains perceived control over ejaculation, personal distress related to ejaculation, interpersonal difficulty related to ejaculation, satisfaction with sexual intercourse did not differ between the groups following the surgery. Furthermore, when we compared the pre- and postoperative scores of the variables, interpersonal difficulty related to ejaculation significantly improved in the severe/moderate EF, and IIEF EF domain and PEP interpersonal difficulty related to ejaculation scores were significantly higher in the postoperative period for the moderate/mild/no ED group, suggesting an ameliorating effect of metabolic surgery and weight loss on EF.

Erection is mediated through the NO release that involves in stimulation of corpus cavernosum smooth muscle allowing blood supply to provide erection [20]. Lower adipokine levels in obese and T2DM patients resulted in lack of NO, thus endothelial dysfunction contributing to ED. Significant weight loss is associated with a better erection capacity, through organic pathways and increasing self-confidence [13]. In addition, weight loss percentage on the postoperative 6th month was significantly higher in the moderate/mild/no ED group, possibly affecting the improvement of scoring variables. Although we lack further data on the long-term results of the variables, it might be suggested that further improvements of other scoring parameters would be expected in both groups.

There is a close relationship between the HbA1c levels and the severity of the ED, and studies reported improved erectile function due to HbA1c reduction and control of T2DM in male individuals younger than 60 years old [21, 22]. Furthermore, ED is considered among the initial symptoms of T2DM in 12% of patients [23]. In our study, there was significant reduction in HbA1c levels on the postoperative sixth month in both groups independent of the severity of the ED. However, improved IIEF EF domain score in the mild to moderate/mild/no ED group might be due to relatively younger age of individuals in this group, supporting the findings on beneficial effect of glycemic control on ED in younger patients.

It should also be taken into account that the surgery type we performed on our patients was a relatively novel method SG+TB, and variabilities on the postoperative period might be observed as a result of the surgical method on different organ systems and pathways. Thus, similar studies are required with

male patient groups who underwent weight loss procedures such as sleeve gastrectomy, Roux-en-Y gastric bypass, or gastric banding. Furthermore, phychological evaluations are required questioning the self-evaluation of the individuals regarding their body perception and self-confidence prior to and following the surgery.

One limitation of our study is that we did not analyze testosterone, SHBG, and lipid profile markers of the patients on the pre- and postoperative follow-up periods. In addition, we did not perform imaging analyses on the blood supply level of the penile vessels. However, we can conclude from previous studies that, either with the effect of metabolic surgery or weight loss, an ameliorated lipid profile is a predicted consequence alongside other metabolic variables. We also observed significantly lower HbA1c levels at the end of the 6-month follow-up period for both groups.

In conclusion, metabolic surgery could improve erectile and ejaculatory function scores of obese patients with T2DM. Large-scale studies with similar age groups and longer follow-up would exhibit better scores during the time course on the variables that did not improve on the early postoperative period.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Statement Informed consent was obtained from all individual participants included in the study.

References

1. Shamloul R, Ghanem H. Erectile dysfunction. Lancet. 2013;381(9861):153–65. https://doi.org/10.1016/S0140-6736(12)60520-0.
2. Lewis RW, Fugl-Meyer KS, Corona G, et al. Definitions/epidemiology/risk factors for sexual dysfunction. J Sex Med. 2010;7(4 Pt 2):1598–607. https://doi.org/10.1111/j.1743-6109.2010.01778.x.
3. Keating NL, O'Malley AJ, Freedland SJ, et al. Diabetes and cardiovascular disease during androgen deprivation therapy: observational study of veterans with prostate cancer. J Natl Cancer Inst. 2010;102:39–46.
4. Traish AM, Feeley RJ, Guay A. Mechanisms of obesity and related pathologies: androgen deficiency and endothelial dysfunction may be the link between obesity and erectile dysfunction. FEBS J. 2009;276:5755–67.
5. Wang C, Jackson G, Jones TH, et al. Low testosterone associated with obesity and the metabolic syndrome contributes to sexual dysfunction and cardiovascular disease risk in men with type 2 diabetes. Diabetes Care. 2011;34(7):1669–75. https://doi.org/10.2337/dc10-2339.
6. Rubino F, Nathan DM, Eckel RH, et al. Metabolic surgery in the treatment algorithm for type 2 diabetes: a joint statement by international diabetes organizations. Diabetes Care. 2016;39(6):861–77. https://doi.org/10.2337/dc16-0236.
7. Santoro S, Castro LC, Velhote MC, et al. Sleeve gastrectomy with transit bipartition: a potent intervention for metabolic syndrome and obesity. Ann Surg. 2012;256(1):104–10. https://doi.org/10.1097/SLA.0b013e31825370c0.
8. Xu J, Wu Q, Zhang Y, et al. Effect of bariatric surgery on male sexual function: a meta-analysis and systematic review. Sex Med. 2019;7(3):270–81. https://doi.org/10.1016/j.esxm.2019.06.003.
9. Traish AM, Goldstein I, Kim NN. Testosterone and erectile function: from basic research to a new clinical paradigm for managing men with androgen insufficiencyand erectile dysfunction. Eur Urol. 2007;52:54–70.
10. Rosen R, Riley A, Wagner G, et al. The International Index of Erectile Function (IIEF): a multidimensional scale for assessment of erectile dysfunction. Urology. 1997;49:822–30.
11. Shabsigh R, Rowland D. The Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision as an appropriate diagnostic for premature ejaculation. J Sex Med. 2007;4:1468–78.
12. Gorgel SN, Gorgel A, Sefik E. Sexual function in male patients with metabolic syndrome and effective parameters on erectile dysfunction. Int Braz J Urol. 2014;40(1):56–61. https://doi.org/10.1590/S1677-5538.IBJU.2014.01.08.
13. Malavige LS, Levy JC. Erectile dysfunction in diabetes mellitus. J Sex Med. 2009;6(5):1232–47. https://doi.org/10.1111/j.1743-6109.2008.01168.x.
14. Corona G, Monami M, Rastrelli G, et al. Type 2 diabetes mellitus and testosterone: a meta-analysis study. Int J Androl. 2011;34(6 Pt 1):528–40. https://doi.org/10.1111/j.1365-2605.2010.01117.x.
15. Colangelo LA, Ouyang P, Liu K, et al. Association of endogenous sex hormones with diabetes and impaired fasting glucose in men: multi-ethnic study of atherosclerosis. Diabetes Care. 2009;32:1049–51.
16. Andersson B, Marin P, Lissner L, et al. Testosterone concentrations in women and men with NIDDM. Diabetes Care. 1994;17:405–11.
17. Jones TH, Saad F. The effects of testosterone on risk factors for, and the mediators of, the atherosclerotic process. Atherosclerosis. 2009;207:318–27.
18. Cohen PG. The hypogonadal-obesity cycle: role of aromatase in modulating the testosteroneestradiol shunt—a major factor in the genesis of morbid obesity. Med Hypotheses. 1999;52:49–51.
19. Aleid M, Muneer A, Renshaw S, et al. Early effect of bariatric surgery on urogenital function in morbidly obese men. J Sex Med. 2017;14(2):205–14. https://doi.org/10.1016/j.jsxm.2016.12.004.
20. Chitaley K. Type 1 and type 2 diabetic-erectile dysfunction: same diagnosis (ICD-9), different disease? J Sex Med. 2009;6(Suppl 3):262–8. https://doi.org/10.1111/j.1743-6109.2008.01183.x.
21. Gratzke C, Angulo J, Chitaley K, et al. Anatomy, physiology, and pathophysiology of erectile dysfunction. J Sex Med. 2010;7(1 Pt 2):445–75. https://doi.org/10.1111/j.1743-6109.2009.01624.x.
22. Corona G, Mondaini N, Ungar A, et al. Phosphodiesterase type 5 (PDE5) inhibitors in erectile dysfunction: the proper drug for the proper patient. J Sex Med. 2011;8(12):3418–32. https://doi.org/10.1111/j.1743-6109.2011.02473.x.
23. Hirshkowitz M, Karacan I, Arcasoy MO, et al. Prevalence of sleep apnea in men with erectile dysfunction. Urology. 1990;36:232–4.