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The effect of overweight and obesity on the severity of manifestations of chronic nonbacterial prostatitis with an inflammatory component

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ABSTRACT

BACKGROUND: Chronic prostatitis is one of the most common urological diseases of young and middle-aged men. The variety of pathogenetic mechanisms and clinical manifestations, the tendency to recurrence necessitates the search for new methods of examination and monitoring of this disease.

AIM: To identify the characteristics of the clinical manifestations of chronic non-bacterial prostatitis with an inflammatory component in men of the first period of adulthood, depending on the body mass index.

MATERIALS AND METHODS: A comprehensive urological examination was carried out on 150 men with chronic non-bacterial prostatitis in the first period of adulthood, aged 22 to 35 years. All patients were assessed for hormonal status, as well as anthropometric parameters.

RESULTS: Men with normal body mass index had milder clinical symptoms of prostatitis compared with overweight and obese patients. The results of laboratory studies demonstrated a more pronounced inflammatory process and dysfunction of the prostate in patients with a higher body mass index. Analysis of hormonal status revealed high levels of total and free testosterone and low levels of estradiol in men with normal body mass index. The content of sex hormone-binding globulin was significantly lower in obese patients. Overweight and obese men also had larger prostate volume according to TRUS.

CONCLUSIONS: More severe manifestations of prostatitis are associated with an increase in body mass index.

Keywords: chronic prostatitis; body mass index; somatometry.

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Влияние избыточной массы тела и ожирения на тяжесть проявлений хронического небактериального простатита с воспалительным компонентом

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АННОТАЦИЯ

Актуальность. Хронический простатит — одно из самых распространенных урологических заболеваний мужчин молодого и среднего возраста. Обилие патогенетических механизмов и клинических проявлений, склонность к рецидивирующему течению обусловливают необходимость тщательного клинического обследования, своевременного лечения и профилактики этого патологического состояния.

Цель — выявление особенностей клинических проявлений хронического небактериального простатита с воспалительным компонентом у мужчин первого периода зрелого возраста в зависимости от показателя индекса массы тела.

Материалы и методы. Проведено комплексное урологическое обследование 150 мужчин с хроническим небактериальным простатитом с воспалительным компонентом первого периода зрелого возраста от 22 до 35 лет. Всем пациентам оценивали гормональный статус, а также антропометрические показатели.

Результаты. Мужчины с нормальным индексом массы тела имели более легкую клиническую симптоматику заболевания по сравнению с пациентами с избыточной массой тела и ожирением. Результаты лабораторных исследований демонстрировали более выраженный воспалительный процесс и нарушение функции предстательной железы у пациентов с более высоким индексом массы тела. Анализ гормонального статуса выявил высокие уровни общего, свободного тестостерона и низкое содержание эстрадиола у мужчин с нормальным индексом массы тела. Содержание глобулина, связывающего половые гормоны, было значимо ниже у пациентов с ожирением. Мужчины с избыточной массой тела и ожирением имели также больший объем простаты по данным трансректального ультразвукового исследования.

Выводы. Более тяжелые проявления хронического небактериального простатита с воспалительным компонентом ассоциированы с увеличением значения индекса массы тела.

Ключевые слова: хронический простатит; индекс массы тела; соматометрия.

Как цитировать

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ЭКО•ВЕКТОР

BACKGROUND

The World Health Organization (WHO) regards overweight and obesity as a global epidemic of the 21st century that must be addressed. According to epidemiological studies in Russia, the prevalence of overweight and obesity in older males and individuals aged 20 to 40 years is 70% and 40%, respectively [1, 2]. According to the NCD Risk Factor Collaboration's review, which included 1,698 population studies with a total of 19.2 million participants, the prevalence of obesity in males increased from 3.2% in 1975 to 10.8% in 2014. Severe obesity was observed in 2.3% of males worldwide. The prevalence of obesity in males by 2025 is estimated to be 18%, with the incidence of severe obesity exceeding 6% [3].

Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. Obesity is primarily diagnosed and classified using the body mass index (BMI), which is a straightforward but limited criterion. Moreover, obesity is associated with a variety of comorbidities. Almost all body systems are affected, including the cardiovascular, endocrine, digestive, respiratory, musculoskeletal, urogenital, and reproductive system, with the risk of sexual dysfunction, androgen deficiency, prostate cancer, and infertility [4–6].

According to epidemiological studies, 19% of males in Russia have prostatitis [7]. Between 2008 and 2017, the prostate disease detection rate grew by more than 30%, with chronic prostatitis/chronic pelvic pain syndrome ranking third among all prostate diseases [8].

Given the high prevalence of obesity and chronic prostatitis in young men, as well as pathogenetic association of the former with prostate diseases, one of the most pressing issues in modern urology is understanding the relationship between chronic prostatitis/chronic pelvic pain syndrome manifestations and overweight.

The aim of this study was to determine the clinical symptoms of chronic nonbacterial prostatitis (CNBP) in males in early adulthood based on their BMI.

MATERIALS AND METHODS

The study was performed in the day care inpatient unit of Krasnoyarsk Interdistrict Clinical Hospital No. 4 from 2018 to 2022. The study included males with confirmed CNBP in early adulthood, according to the human ontogenesis age categorization adopted at the 7th All-Union Conference on Age-appropriate Morphology, Physiology, and Biochemistry of the USSR Academy of Pedagogical Sciences in 1965. The diagnosis of CNBP, which corresponds to NIH-PSC (1999) category IIIa chronic prostatitis/chronic pelvic pain syndrome, was based on the following: distinct clinical presentation, duration of the disease, prostatic fluid microscopy (leukocytes >10 per FOV), culture tests for aerobic and facultative anaerobic opportunistic pathogens and *Candida* fungi (absence of culture growth in a significant titer), and molecular genetic testing (PCR) of an anterior urethral smear and prostate fluid for *Trichomonas vaginalis*, *Mycoplasma hominis*, *Mycoplasma genitalium*, *Chlamydia trachomatis*, *Nisseria gonorrhea*, and *Ureaplasma urealyticum*. Exclusion criteria: severe somatic condition, HIV infection, the presence of pathogens listed above based on positive culture tests and/or PCR, and patient non-compliance with the study protocol.

In total, 150 males with CNBP in early adulthood (22–35 years) were examined during the study. The median age was 31 [28; 34] years. The duration of CNBP ranged from 3 months to 12 years (median: 2 [0.25; 3] years).

The Chronic Prostatitis Symptom Index (CSPI), a standardized questionnaire assessing the severity of pain and dysuria, as well as their impact on quality of life and daily activities, was used to objectively and quantitatively assess the main manifestations of the disease in CNBP patients [9]. Sexual dysfunction (libido disorders and erectile dysfunction, their duration, and quality of life) was assessed using the Male Sexual Formula (MSF) score proposed by Professor G.S. Vasilchenko et al. [10].

BMI was calculated for all patients using the following formula: body weight (kg) / height $(m)^2$. The WHO classifies 18.5–24.9 kg/m^2 BMI as normal body weight, 25–29.9 kg/m^2 as pre-obesity (overweight), and ⩾ 30 kg/m^2 as obesity [11]. Additional laboratory testing included a complete blood count and hormone blood tests: total and free testosterone, sex hormone-binding globulin (SHBG), and estradiol. Free testosterone was calculated using the International Society for the Study of the Aging Male (ISSAM) calculator (reference: >0.250 nmol/L). Total testosterone, estradiol, and SHBG were measured using the Immulite Immunoassay System (Diagnostic Products Corporation, USA). The enhanced chemiluminescence enzyme immunoassay was used as a detection method. The instrumental examination was performed using transrectal ultrasonography (TRUS) of the prostate.

Statistical analysis was performed using StatTech v.3.1.10 software (Stattech LLC, Russia). The Shapiro–Wilk test (<50 subjects) or Kolmogorov test (> 50 subjects) were used to determine the normal distribution of quantitative variables. In cases of non-normal distribution, quantitative variables were reported as median (*Me*) and upper and lower quartiles [Q_1; Q_3]. Categorical variables were reported as absolute values and percentages. When comparing two groups by a quantitative variable with non-normal distribution, the Mann–Whitney *U* test was used. When comparing three and more groups by a quantitative variable with non-normal distribution,

the Kruskall–Wallis test was used; post-hoc comparisons were made using the Dunn test adjusted by the Holm method. When analyzing four-way and multi-way contingency tables, percentages were compared using the Pearson's chi-squared test (with anticipated event values >10). The direction and strength of the correlation between two quantitative variables were assessed using the Spearman's rank correlation coefficient (for non-normal distribution). The differences were considered significant at $p < 0.05$.

RESULTS

Anthropometric parameters of the study subjects are presented in Table 1.

BMI corresponding to normal body weight, overweight, and obesity was reported in 73 (48.7%), 64 (42.7%), and 13 (8.7%) patients, respectively. Abdominal obesity was reported in 35 (23.3%) patients.

An analysis of CNBP symptoms according to the CPSI score revealed that a higher BMI was associated with a higher clinical index (CI), as a summary parameter of pain, dysuria, and quality of life. The median CI for BMI corresponding to normal body weight, overweight, and obesity was 19 [17; 24], 24 [18; 28], and 30 [27; 32] points, respectively. The differences were significant: P (normal body weight–overweight) = 0.008, p (normal body weight–obesity) < 0.001, and P (overweight–obesity) = 0.009.

The incidence of severe CNBP manifestations in patients with obesity was significantly higher ($p < 0.05$) than in patients with overweight and normal BMI (Fig. 1).

A sexual function assessment using the MSF score revealed a significant decrease in libido, sexual intercourse quality, and psychological assessment of sexual life in males with overweight and obesity, with the most severe dysfunction observed in the latter (Table 2).

According to laboratory findings, a higher BMI in CNBP patients was associated with a higher leukocyte count and a lower number of lipid droplets. Males with obesity had the highest leukocyte count and the lowest number of lipid droplets, while overweight patients showed intermediate values compared to patients with obesity and normal BMI (Fig. 2).

Hormone analysis of CNBP patients based on the BMI showed a significant decrease in SHBG, total testosterone, and free testosterone with elevated estradiol in males with obesity. Males with normal BMI had the highest total and free testosterone and the lowest estradiol levels (Table 3).

An ultrasound examination revealed that patients with a higher BMI had a larger prostate. The mean prostate volume was 20 [19; 22] cm^3 in patients with normal BMI (18.5–24.9) and 28 [26; 30] cm^3 in patients with obesity (⩾30) ($p < 0.05$).

A correlation between clinical laboratory parameters and BMI was analyzed (Table 4). A strong direct

Table 1. Anthropometric characteristics of patients with chronic abacterial prostatitis with an inflammatory component (n = 150)

Таблица 1. Антропометрическая характеристика пациентов с хроническим небактериальным простатитом с воспалительным компонентом (n = 150)

Parameter	*Me*	Q_1; Q_3	min	max
Height, cm	179	175; 183	158	197
Body weight, kg	80	74; 87	60	140
Waist circumference, cm	91	84; 95	72	120
Body mass index, kg/m^2	25	23; 28	19	43

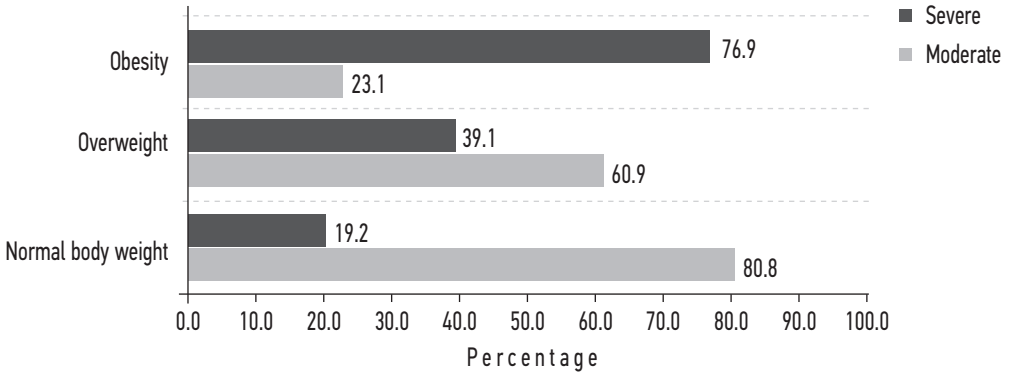

Fig. 1. Frequency of severe and moderate manifestations of chronic abacterial prostatitis with an inflammatory component depending on body mass index

Рис. 1. Частота выраженных и умеренных проявлений хронического небактериального простатита с воспалительным компонентом в зависимости от индекса массы тела

correlation according to the Chaddock scale was observed between BMI and prostate width, height, and volume according to TRUS, as well as a moderate direct correlation between BMI and estradiol level and CI according to the CPSI score. Moreover, BMI had a strong inverse correlation with the total MSF score and total testosterone, as well as a moderate inverse correlation with free testosterone.

DISCUSSION

Males in early adulthood with a higher BMI had more severe clinical laboratory manifestations of CNBP. Obesity and metabolic syndrome are currently considered a chronic inflammatory disease with a complex pathophysiology, where inflammatory cytokines cause asymptomatic prostatitis and prostatic hyperplasia [12–14].

Table 2. Indicators of sexual function on the Sexy male formula scale in patients with chronic abacterial prostatitis with an inflammatory component depending on body mass index values (*n* = 150)

Таблица 2. Показатели половой функции по шкале «Сексуальная формула мужская» у пациентов с хроническим небактериальным простатитом с воспалительным компонентом в зависимости от значений индекса массы тела (*n* = 150)

Parameter	BMI, kg/m^2	*Me*, points	Q_1; Q_3	*p*
Libido	18.5–24.9	9	8; 10	*p* (normal body weight–overweight) < 0.001 *p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) < 0.001
	25.0–29.9	8	7; 9	
	⩾30	7	6; 7	
Erection and ejaculation	18.5–24.9	9	8; 9	*p* (normal body weight–overweight) = 0.005 *p* (normal body weight–obesity) = 0.004
	25.0–29.9	8	8; 9	
	⩾30	8	7; 8	
Psychological assessment of sexual life	18.5–24.9	9	8; 9	*p* (normal body weight–overweight) < 0.001 *p* (normal body weight–obesity) < 0.001
	25.0–29.9	8	7; 9	
	⩾30	7	6; 7	
Total	18.5–24.9	30	28; 31	*p* (normal body weight–overweight) < 0.001 *p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) = 0.009
	25.0–29.9	26	24; 29	
		23	22; 24	

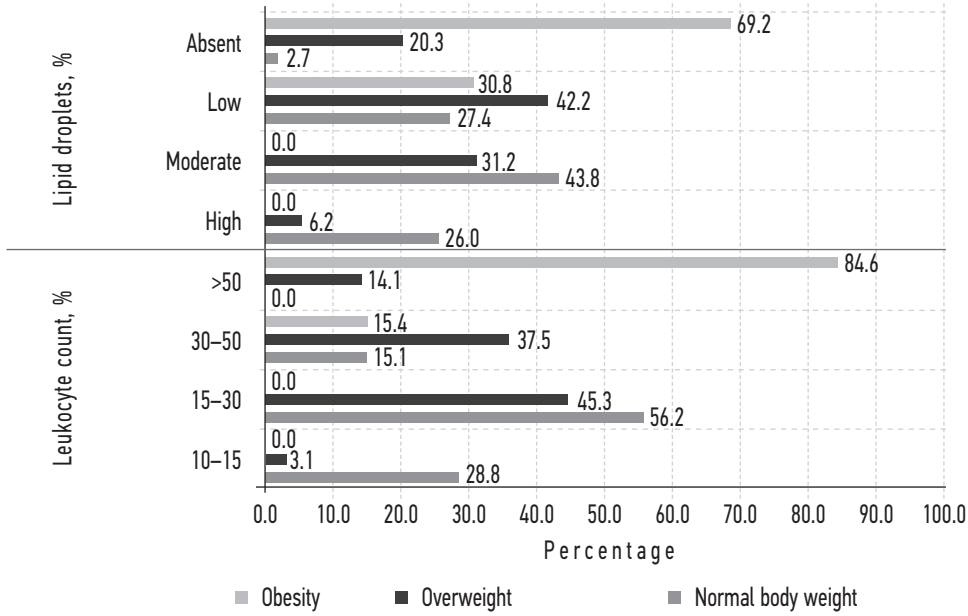

Fig. 2. Results of microscopic examination of prostate secretion in patients with chronic abacterial prostatitis with an inflammatory component depending on body mass index values (*n* = 150)

Рис. 2. Результаты микроскопического исследования секрета простаты у пациентов с хроническим небактериальным простатитом с воспалительным компонентом в зависимости от значений индекса массы тела (*n* = 150)

Table 3. Hormonal status of patients with chronic abacterial prostatitis with an inflammatory component depending on body mass index values (n = 150)

Таблица 3. Гормональный статус пациентов с хроническим небактериальным простатитом с воспалительным компонентом в зависимости от значений индекса массы тела (n = 150)

Parameter	BMI, kg/m^2	*Me*	Q_1; Q_3	*p*
Testosterone	18.5–24.9	20	20; 22	*p* (normal body weight–overweight) < 0.001 *p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) < 0.001
	25.0–29.9	19	17; 21	
	⩾30	15	13; 15	
Estradiol	18.5–24.9	62	58; 70	*p* (normal body weight–overweight) = 0.003 *p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) = 0.007
	25.0–29.9	68	60; 80	
	⩾30	80	78; 80	
Sex hormone-binding globulin	18.5–24.9	37	33; 38	*p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) < 0.001
	25.0–29.9	37	31; 38	
	⩾30	28	23; 29	
Free testosterone	18.5–24.9	412	385; 461	*p* (normal body weight–overweight) = 0.007 *p* (normal body weight–obesity) < 0.001 *p* (overweight–obesity) = 0.007
	25.0–29.9	396	339; 432	
		338	311; 358	

Table 4. Correlation between body mass index values and clinical and laboratory parameters in patients with chronic abacterial prostatitis with an inflammatory component (n = 150)

Таблица 4. Корреляционные связи между значениями индекса массы тела и клинико-лабораторными показателями у пациентов с хроническим небактериальным простатитом с воспалительным компонентом (n = 150)

Parameter	Correlation characteristics		
	ρ	Correlation strength according to the Chaddock scale	*p*
BMI–CI	0.429	Moderate	<0.001
BMI–Total MSF score	–0.578	High	<0.001
BMI–Testosterone	–0.620	High	<0.001
BMI–Estradiol	0.465	Moderate	<0.001
BMI–SHBG	–0.256	Слабая	0.002
BMI–Free testosterone	–0.456	Moderate	<0.001
BMI–Length (TRUS, anteroposterior)	0.214	Low	0.009
BMI–Width (TRUS)	0.557	High	<0.001
BMI–Height (TRUS)	0.504	High	<0.001
BMI–Volume (TRUS)	0.535	High	<0.001

Note. BMI, body mass index; CI, clinical index; SHBG, sex hormone-binding globulin; TRUS, transrectal ultrasonography of the prostate; MSF, Male Sexual Formula.

Literature analysis suggests that obesity is a significant pathogenetic factor in both chronic prostatitis and male infertility. Obesity and its key mediators are known to have a negative impact on sperm parameters such as concentration, motility, vitality, and morphology [13, 15]. Disrupted androgen metabolism in males with obesity contributes significantly to the pathogenesis of lower urinary tract symptoms, prostate diseases, and sexual dysfunctions [16, 17]. This study revealed a significant inverse correlation between BMI and total and free testosterone: both of these parameters decreased with an increase in BMI.

CONCLUSIONS

This study revealed a correlation between clinical laboratory CNBP parameters and BMI in patients in early adulthood. More severe CNBP symptoms were associated with a higher BMI. Given the identified patterns, comprehensive assessment and improvement of BMI require an

interdisciplinary approach, while urologists should consider BMI in the diagnosis, treatment, and follow-up care of males with CNBP.

ADDITIONAL INFORMATION

Authors' contribution. All authors have made a significant contribution to the development of the concept, research, and preparation of the article, as well as read and approved the final version before its publication. Personal contribution of the authors: A.A. Amelchenko — reviewing of publications on the article's theme, research procedures, data collection, analysis of the obtained data, article writing; Yu.Yu. Vinnik — development of the article's design, reviewing of publications on the article's theme, analysis of the obtained data, scientific editing of the text.

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Ethics approval. The study participants were informed about the objectives and methodology of the study and voluntarily provided written consent for their participation.

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