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Features of detrusor function disorders in patients with dysuria in the long period after transurethral resection of the prostate

Ruslan N. Simanov [1, 2], Refat E. Amdiy [3], Igor V. Kuzmin [3]

[1] Petrozavodsk State University, Petrozavodsk, Republic of Karelia, Russia;
[2] Republican Hospital named after V.A. Baranov, Petrozavodsk, Republic of Karelia, Russia;
[3] Academician I.P. Pavlov First St. Petersburg State Medical University, Saint Petersburg, Russia

ABSTRACT

BACKGROUND: Transurethral resection of the prostate (TURP) remains the "gold standard" for surgical treatment of patients with benign prostatic hyperplasia. At the same time, a significant number of patients continue to have urinary disorders after surgery. Dysuric disorders may be caused by detrusor dysfunction.

AIM: The aim of the study was to determine the frequency, nature and clinical manifestations of detrusor dysfunction in patients with benign prostatic hyperplasia after TURP in the long-term postoperative period.

MATERIALS AND METHODS: We examined 128 patients with benign prostatic hyperplasia aged from 56 to 87 years (mean 68.5 ± 7.1 years), who underwent TURP 12–36 months before inclusion in the study. All patients had urinary problems at the time of examination. All patients underwent a urological examination, which included a complex urodynamic study. The control group consisted of 48 patients with benign prostatic hyperplasia of comparable age, who did not have urinary disorders after TURP.

RESULTS: Urodynamic signs of detrusor dysfunction were identified in 97 (75.8%) of 128 patients examined. Most often, isolated detrusor overactivity was detected (52.6%), less often a combination of detrusor over- and hypoactivity (25.8%) and isolated detrusor hypoactivity (21.7%). In patients with identified detrusor dysfunction, even before TURP, more pronounced urinary disorders were noted, which were characteristic of a certain type of detrusor dysfunction and persisted after surgical treatment. In patients with detrusor dysfunction, compared with patients from the control group, at the preoperative stage, urgency urinary incontinence, frequent urgency to urinate, diabetes mellitus, and a small volume of the prostate gland with the absence of intravesical protrusion were significantly more often detected.

CONCLUSIONS: Detrusor dysfunction is an important cause of dysuria in patients with benign prostatic hyperplasia in the long-term period after TURP. It seems appropriate to conduct further research to clarify the indications for performing preoperative complex urodynamic study in patients with benign prostatic hyperplasia and lower urinary tract symptoms.

Keywords: benign prostatic hyperplasia; lower urinary tract symptoms; transurethral resection of the prostate; detrusor overactivity; detrusor underactivity.

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Особенности нарушений функции детрузора у пациентов с дизурией в отдаленном периоде после трансуретральной резекции предстательной железы

Р.Н. Симанов [1, 2], Р.Э. Амдий [3], И.В. Кузьмин [3]

[1] Петрозаводский государственный университет, Петрозаводск, Россия;
[2] Республиканская больница им. В.А. Баранова, Петрозаводск, Россия;
[3] Первый Санкт-Петербургский государственный медицинский университет им. акад. И.П. Павлова, Санкт-Петербург, Россия

АННОТАЦИЯ

Актуальность. Трансуретральная резекция предстательной железы (ТУРП) остается золотым стандартом хирургического лечения больных доброкачественной гиперплазией предстательной железы (ДГПЖ). При этом у значительного числа больных после операции сохраняются расстройства мочеиспускания. Причиной дизурических расстройств могут быть нарушения функции детрузора.

Цель — определение частоты, характера и клинических проявлений дисфункции детрузора у больных ДГПЖ после ТУРП в отдаленном послеоперационном периоде.

Материалы и методы. Проведено обследование 128 пациентов с ДГПЖ в возрасте от 56 до 87 лет (в среднем 68,5 ± 7,1 года), которым выполняли ТУРП за 12–36 мес. до включения в исследование. У всех пациентов на момент обследования сохранялись нарушения мочеиспускания. Всем больным проведено урологическое обследование, включавшее комплексное уродинамическое исследование. Контрольную группу составили 48 пациентов с ДГПЖ сопоставимого возраста, у которых расстройств мочеиспускания после ТУРП не отмечалось.

Результаты. Уродинамические признаки дисфункций детрузора выявлены у 97 (75,8 %) из 128 обследованных пациентов. Чаще всего диагностировали изолированную гиперактивность детрузора (52,6 %), реже комбинацию гипер- и гипоактивности детрузора (25,8 %) и изолированную гипоактивность детрузора (21,7 %). У пациентов с выявленными дисфункциями детрузора еще до выполнения ТУРП были отмечены более выраженные расстройства мочеиспускания, причем характерные для определенного вида дисфункции детрузора и сохраняющиеся после хирургического лечения. У таких пациентов по сравнению с больными из контрольной группы на дооперационном этапе достоверно чаще выявляли ургентное недержание мочи, частые императивные позывы на мочеиспускание, сахарный диабет и малый объем предстательной железы с отсутствием интравезикальной протрузии.

Выводы. Дисфункции детрузора являются важной причиной дизурии у больных ДГПЖ в отдаленном периоде после ТУРП. Представляется целесообразным проведение дальнейших исследований для уточнения показаний к выполнению предоперационного комплексного уродинамического исследования у пациентов с ДГПЖ и симптомами нижних мочевыводящих путей.

Ключевые слова: доброкачественная гиперплазия предстательной железы; симптомы нижних мочевыводящих путей; трансуретральная резекция предстательной железы; гиперактивность детрузора; гипоактивность детрузора.

Как цитировать

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BACKGROUND

Benign prostatic hyperplasia (BPH) is a highly prevalent disease that causes dysuria, reduces quality of life, and frequently leads to severe complications [1]. BPH-induced infravesical obstruction (IVO) causes significant functional and morphological changes in the detrusor due to bladder ischemia, partial denervation, and impaired electrical activity of detrusor smooth muscle cells [2–5]. Transurethral resection of the prostate (TURP) remains the "gold standard" for surgical treatment of BPH up to 80 cm^3 [6–8]. According to various studies, 5–49% of patients after TURP still have lower urinary tract symptoms (LUTS) in the long-term postoperative period; 9–17% of patients have unsatisfactory surgical outcomes; and 7% of patients regard their post-surgery quality of life as poor or very poor [9–12]. Dysuria following TURP may be caused by detrusor dysfunction that was not discovered prior to surgery. It is critical to assess the incidence and nature of detrusor dysfunction in patients with BPH after TURP who have persistent dysuria in the long-term postoperative period.

The aim of the study was to assess the incidence, nature, and clinical manifestations of detrusor dysfunction in patients with BPH after TURP in the long-term postoperative period.

MATERIALS AND METHODS

The study included 128 patients with BPH who underwent TURP between 2018 and 2021 in the Urology Clinic of the Pavlov First St. Petersburg State Medical University and the Urology Department of the Baranov Republican Hospital (Petrozavodsk) and had dysuria of varying severity 12–36 months post-surgery. The study subjects ranged in age from 56 to 87 years (mean: 68.5 ± 7.1 years), with patients aged 60 years and older making up 94/128 (73.4%). Among the study subjects, 118 (92.2%) had comorbidities that required drug therapy, including hypertension, coronary artery disease, chronic heart failure, a history of myocardial infarction and acute cerebrovascular accident, chronic obstructive pulmonary disease, and asthma. Type 1 and 2 diabetes was reported in 16 (13.6%) patients.

First, patients signed an informed consent form. History collection, a survey using the International Prostate Symptom Score (IPSS), a bladder diary (for three days), urinalysis, kidney, prostate, and bladder ultrasound with residual urine measurement, and uroflowmetry were used to assess the severity of symptoms, quality of life, and long-term TURP outcomes. The survey and examination were conducted 12–36 months post-surgery (mean: 29.2 ± 0.8 months). The medical history and pre-surgery medical records were reviewed to assess the symptoms and key clinical parameters. A comprehensive urodynamic study (UDS) was performed in 128 (72.7%) patients with persistent dysuria to determine the cause of dysuria after TURP in the long-term postoperative period. The terminology, equipment, and UDS methods comply with the 2019 guidelines of the Standardization Steering Committee of the International Continence Society (ICS) [13].

The inclusion criteria were as follows: TURP for BPH 1 to 3 years prior to examination; no intraoperative and early postoperative complications; Eastern Cooperative Oncology Group (ECOG) performance status ⩽3; signed informed consent form; and LUTS in the long-term postoperative period after TURP (1 to 3 years prior to examination).

The exclusion criteria were as follows: a history of pelvic cancer; pelvic surgery, except for TURP; significant complications during TURP; neurological diseases; surgical treatment of urinary incontinence; acute or exacerbated chronic urinary tract infections; and inability to follow doctor's instructions due to compromised physical or psychoemotional health.

The control group included 48 patients with BPH who underwent TURP 12–36 month prior to inclusion in the study and had no complaints of dysuria during the examination.

The data were analyzed using descriptive statistics, which included calculating mean values, standard deviations, and standard errors of the mean for numerical variables. The results are presented as $M \pm m$ for numerical variables and n (%) for frequencies. The significance of between-group differences in mean values was assessed using the Student's t-test. The significance of between-group differences in frequencies was assessed using the χ^2 test. All calculations were performed using Excel, Statistica 12.0, and specialized *R* libraries.

RESULTS

Nocturia was reported by 69 (53.9%) patients, weak stream by 33 (25.8%), frequent urination by 26 (20.3%), intermittent urination by 24 (18.8%), straining by 20 (15.6%), incomplete emptying by 19 (14.8%), and urgency by 17 (13.3%) (see Figure). Thus, the most common complaints reported after TURP in the long-term postoperative period were nocturia, weak stream, and frequent urination.

According to UDS, detrusor dysfunction was the main cause of dysuria in 97 (75.8%) patients: 51 (52.6%) patients had detrusor overactivity, 21 (21.7%) had detrusor underactivity, and 25 (25.8%) had both.

Among the 128 examined patients, 22 (17.2%) had signs of IVO, whereas 9 (7.0%) had signs of urethral sphincter insufficiency. Retrograde urethrography and cystoscopy were performed in 22 patients with urodynamically confirmed IVO to clarify the cause: urethral stricture was detected in 8 (36.4%) patients, bladder neck

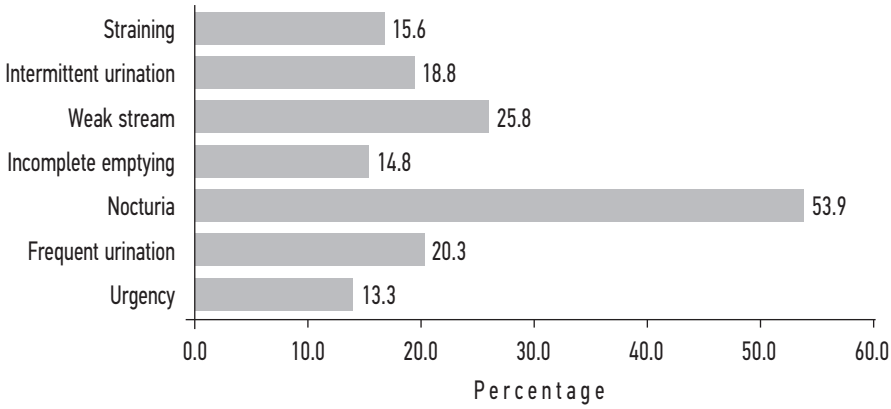

Figure. Symptoms of urinary disorders after transurethral resection of the prostateTURP in the long-term post-operative period (n = 128)
Рисунок. Симптомы расстройств мочеиспускания после трансуретральной резекции предстательной железы ТУРП в отдаленном послеоперационном периоде (n = 128)

Table 1. Main clinical parameters in patients with benign prostatic hyperplasia with urinary disorders after transurethral resection of the prostate, $M \pm m$ (n = 97)

Таблица 1. Основные клинические показатели у пациентов с доброкачественной гиперплазией предстательной железы с расстройствами мочеиспускания после трансуретральной резекции предстательной железы, $M \pm m$ (n = 97)

Parameter	Detrusor overactivity (n = 51)	Detrusor underactivity (n = 21)	Coexisting hyperactive–underactive bladder (n = 25)
IPSS, total score	20.1 ± 1.9	17.9 ± 2.1	18.4 ± 3.4
IPSS, storage symptoms (Questions 2, 4, and 7), score	11.4 ± 1.1	4.1 ± 0.7*	7.2 ± 1.4*
IPSS, voiding symptoms (Questions 1, 3, 5, and 6), score	8.7 ± 0.8	13.8 ± 1.4*	11.2 ± 2.0
QoL, score	4.7 ± 1.1	4.6 ± 0.8	4.4 ± 0.5
Q_{max}, mL/s	17.3 ± 2.7	10.7 ± 1.4*	10.8 ± 0.7*
Prostate volume, cm^3	39.1 ± 9.1	36.5 ± 6.1	35.2 ± 7.1
Residual urine volume, mL	18.2 ± 6.3	142.6 ± 20.2*	106.5 ± 14.3*
Mean daytime urination frequency	10.9 ± 0.7	6.7 ± 0.5*	8.5 ± 0.6*
Mean nighttime urination frequency	2.5 ± 0.2	1.5 ± 0.2*	2.3 ± 0.2
Mean frequency of urgency per day	5.4 ± 1.0	0.2 ± 0.1*	3.2 ± 0.3*

Note. Here and in Tables 2–5: QoL, quality of life; Q_{max}, peak flow rate according to uroflowmetry. *Significant difference compared to patients with detrusor overactivity (p < 0,05).

sclerosis in 10 (45.4%), and recurrent BPH in 4 (18.2%). Moreover, 8 (36.4%) patients with IVO had detrusor overactivity, and 3 (13.6%) had detrusor underactivity. These patients received treatment for detrusor overactivity 3 months after revision surgery (optical internal urethrotomy, urethroplasty, transurethral resection of the bladder neck, or TURP). The scope of this paper does not include the outcomes of detrusor overactivity and underactivity treatment in this group of patients, nor the outcomes of urethral sphincter insufficiency treatment.

Patients with detrusor overactivity have more severe storage symptoms, a higher peak flow rate, and a lower residual urine volume than patients with detrusor underactivity or coexisting hyperactive–underactive bladder (Table 1).

The next stage of the study was a retrospective analysis of symptoms and key clinical parameters prior to TURP. To do so, the medical history and outpatient medical records were reviewed.

Table 2 shows the examination findings in patients with detrusor overactivity before and after surgery. Following TURP, there was an increase in peak flow rate (Q_{max}) and a decrease in residual urine volume vs. baseline, with a decrease in the total IPSS score representing voiding symptoms (p < 0.05). There were no significant changes in the total IPSS score or the total score for voiding symptoms. Moreover, there was no significant improvement in quality of life after TURP in the long-term postoperative period.

Table 2. Main clinical parameters in patients with detrusor overactivity before and after transurethral resection of the prostate, $M \pm m$ ($n = 51$)

Таблица 2. Основные клинические показатели у пациентов с гиперактивностью детрузора до и после трансуретральной резекции предстательной железы, $M \pm m$ ($n = 51$)

Parameter	Pre-surgery	Post-surgery
IPSS, total score	21.4 ± 2.0	20.1 ± 1.9
IPSS, storage symptoms (Questions 2, 4, and 7), score	11.6 ± 1.1	11.4 ± 1.1
IPSS, urgency (Question 4), score	4.1 ± 0.7	4.3 ± 0.8
IPSS, voiding symptoms (Questions 1, 3, 5, and 6), score	11.1 ± 0.9	8.7 ± 0.8
QoL, score	4.9 ± 1.5	4.7 ± 1.1
Q_{max}, mL/s	10.8 ± 1.8	17.3 ± 2.7*
Residual urine volume, mL	42.9 ± 10.7	18.2 ± 6.3*

*Significant difference compared to patients with detrusor overactivity ($p < 0,05$).

Table 3. Main clinical parameters in patients with detrusor underactivity before and after transurethral resection of the prostate, $M \pm m$ ($n = 21$)

Таблица 3. Основные клинические показатели у пациентов с гипоактивностью детрузора до и после трансуретральной резекции предстательной железы, $M \pm m$ ($n = 21$)

Parameter	Pre-surgery	Post-surgery
Total IPSS, total score	19.8 ± 2.2	17.9 ± 2.1
Total IPSS, storage symptoms (Questions 2, 4, and 7), score	4.5 ± 0.8	4.1 ± 0.7
IPSS, voiding symptoms (Questions 1, 3, 5, and 6), score	15.3 ± 1.3	13.8 ± 1.4
QoL, score	4.9 ± 0.9	4.6 ± 0.8
Q_{max}, mL/s	9.3 ± 1.3	10.7 ± 1.4
Residual urine volume, mL	151.7 ± 36.4	142.6 ± 20.2

Table 4. Main clinical parameters in patients with a combination of detrusor overactivity and detrusor underactivity before and after transurethral resection of the prostate, $M \pm m$ ($n = 25$)

Таблица 4. Основные клинические показатели у пациентов с сочетанием гиперактивности и гипоактивности детрузора до и после трансуретральной резекции предстательной железы, $M \pm m$ ($n = 25$)

Parameter	Pre-surgery	Post-surgery
IPSS, total score	21.4 ± 2.9	18.4 ± 2.4
IPSS, storage symptoms (Questions 2, 4, and 7), score	8.9 ± 1.5	7.2 ± 1.1
IPSS, urgency (Question 4), score	2.9 ± 0.9	3.4 ± 1.0
IPSS, voiding symptoms (Questions 1, 3, 5, and 6), score	12.5 ± 1.4	11.2 ± 1.3
QoL, score	4.7 ± 0.8	4.4 ± 0.5
Q_{max}, mL/s	10.1 ± 0.6	10.8 ± 0.7
Residual urine volume, mL	116.7 ± 23.6	106.5 ± 14.3

In patients after TURP diagnosed with detrusor underactivity in the long-term postoperative period, there were no significant differences in any study parameter compared to baseline (Table 3). The surgery did not improve symptoms according to the IPSS score, quality of life, peak flow rate, or residual urine volume (Table 3).

There was no improvement in all study parameters in the long-term postoperative period after TURP compared to baseline in patients with coexisting hyperactive–underactive bladder (Table 4).

In control patients without dysuria in the long-term postoperative period after TURP, there was a significant

Table 5. Dynamics of the main clinical parameters in patients of the control group before and after transurethral resection of the prostate, $M \pm m$ ($n = 48$)

Таблица 5. Динамика основных клинических показателей у пациентов контрольной группы до и после трансуретральной резекции предстательной железы, $M \pm m$ ($n = 48$)

Parameter	Pre-surgery	Post-surgery
IPSS, total score	26.9 ± 3.2	4.3 ± 1.8*
IPSS, storage symptoms (Questions 2, 4, and 7), score	10.0 ± 3.1	1.9 ± 1.3*
IPSS, urgency (Question 4), score	2.8 ± 1.3	1.0 ± 0.8*
IPSS, voiding symptoms (Questions 1, 3, 5, and 6), score	16.9 ± 1.6	2.4 ± 1.5*
QoL, score	4.1 ± 1.1	1.2 ± 0.6*
Q_{max}, mL/s	9.5 ± 2.3	16.9 ± 1.3*
Residual urine volume, mL	114.1 ± 71.4	14.5 ± 7.6*

*Достоверное различие по сравнению с показателями группы пациентов с гиперактивностью детрузора ($p < 0,05$).

Table 6. Clinical parameters in patients with benign prostatic hyperplasia in the long-term period after transurethral resection of the prostate, $M \pm m$ ($n = 145$)

Таблица 6. Клинические показатели у пациентов с доброкачественной гиперплазией предстательной железы в отдаленном периоде после трансуретральной резекции предстательной железы, $M \pm m$ ($n = 145$)

Risk factors	Patients with detrusor dysfunction ($n = 97$)	Control group ($n = 48$)	χ^2; p
Pre-operative urge incontinence, *n*	13 (13.4%)	1 (2.1%)	4.62; 0.03
Urgency, IPSS score >4, *n*	17 (17.5%)	2 (4.2%)	5.03; 0.03
Type 1 and 2 diabetes, *n*	16 (16.5%)	2 (4.2%)	4.49; 0.04
Prostate volume <35 cm^3, without intravesical protrusion, *n*	26 (26.8%)	5 (10.4%)	5.13; 0.02

improvement in symptoms and key clinical parameters (Table 5). When analyzing the examination findings in these patients, there were no clinical signs characteristic of detrusor overactivity or other types of bladder dysfunction.

Thus, detrusor dysfunction increases the risk of persistent LUTS following TURP. When analyzing pre-surgery parameters, urge incontinence, urgency (IPSS score > 4), diabetes mellitus, and a small prostate volume without intravesical protrusion were significantly more common in patients with detrusor dysfunction than in control patients without dysuria following TURP (Table 6).

DISCUSSION

Detrusor dysfunction, which was detected by UDS in 75.8% of patients with unsatisfactory surgical outcomes, was the most common cause of dysuria in patients with BPH in the long-term postoperative period after TURP. The majority of patients were diagnosed with detrusor overactivity (52.6%); coexisting hyperactive–underactive bladder (25.8%) and detrusor underactivity (21.7%) were less common. The comparison of key clinical parameters before and after TURP revealed that patients with detrusor dysfunction had more severe dysuria prior to surgery, which was characteristic of a specific form of detrusor dysfunction and persisted after surgery.

Pre-operative detrusor overactivity is a significant predictor of persistent storage symptoms, including urge incontinence, in patients after TURP [14, 15]. Age above 70 years, more than three comorbidities, low maximum cystometric capacity, and early high amplitude of involuntary detrusor activity during UDS are significant predictors of persistent detrusor overactivity following TURP [16]. Detrusor dysfunction can be caused by IVO-induced decompensation, neurogenic disorders, chronic bladder ischemia, or a combination of these factors, which is especially common in older patients [17].

Chronic bladder ischemia and oxidative stress are known to play a substantial role in the development of

LUTS, especially in older patients. Experimental studies showed that detrusor dysfunction caused by chronic bladder ischemia can manifest as both detrusor overactivity and detrusor underactivity [18]. Previous studies suggest that intravesical prostatic protrusion is a more reliable predictor of IVO than age, total PSA, total prostate volume, detrusor wall thickness [19], peak flow rate, residual urine volume, and total IPSS score [20]. The degree of intravesical prostatic protrusion significantly correlates with the severity of IVO [21].

The majority of the examined patients were older patients with comorbidities; most of them had signs of detrusor decompensation (detrusor overactivity or coexisting hyperactive–underactive bladder). It is reasonable to assume that in a considerable number of patients with unsatisfactory TURP outcomes, dysuria was caused by detrusor dysfunction rather than IVO. Urgency and urge incontinence are signs of detrusor overactivity. Notably, detrusor overactivity can be induced by IVO, but it is frequently caused by other factors, such as neurogenic diseases, bladder ischemia, and urothelial dysfunction. The study found that unsatisfactory TURP outcomes were associated with a small prostate volume (< 35 cm^3) without intravesical protrusion. This suggests that detrusor overactivity in these patients was not initially induced by IVO. As a result, TURP was ineffective in these patients. They might benefit from adequate conservative therapy [22].

Fisk factors of persistent LUTS in the long-term postoperative period after TURP included pre-operative urge incontinence, frequent and strong urgency, small prostate volume, diabetes mellitus, and the absence of intravesical protrusion. These conditions are associated with a higher risk of detrusor dysfunction and a lower risk of IVO. In the presence of these factors, patients should undergo UDS to determine the severity of IVO and detect detrusor dysfunction prior to surgery.

CONCLUSIONS

Detrusor dysfunction is the main cause of dysuria in patients with BPH in the long-term postoperative period after TURP. Detrusor dysfunction is observed in 75.8% of cases with unsatisfactory surgical outcomes. Detecting detrusor dysfunction not associated with IVO prior to surgery clarifies the eligibility for TURP and, as a result, improves surgical outcomes. UDS is the primary diagnostic method for detrusor dysfunction. Fisk factors of detrusor dysfunction include frequent urgency, urge incontinence, diabetes mellitus, and a small prostate lacking the middle lobe. Further studies are required to clarify the indications for pre-operative UDS in patients with BPH and LUTS.

ADDITIONAL INFORMATION

Authors' contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study. Contribution of each author: R.N. Simanov — collection and analysis of the obtained data, statistical analysis, writing the text of the manuscript; R.E. Amdiy — concept and design of the study, collection and analysis of the data obtained, editing the text of the manuscript; I.V. Kuzmin — concept and design of the study, analysis of the data obtained, editing the text of the manuscript.

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Competing interests. The authors declare that they have no competing interests.

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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AUTHORS' INFO

***Ruslan N. Simanov;** address: 33 Lenina av., Petrozavodsk, 185910, Republic of Karelia, Russia;
ORCID: 0000-0003-1246-7233; eLibrary SPIN: 3747-8245;
e-mail: ruslansimanov@yandex.ru

ОБ АВТОРАХ

***Руслан Николаевич Симанов;** адрес: Россия, 185910, Республика Карелия, Петрозаводск, пр. Ленина, д. 33;
ORCID: 0000-0003-1246-7233; eLibrary SPIN: 3747-8245;
e-mail: ruslansimanov@yandex.ru

* Corresponding author / Автор, ответственный за переписку

AUTHORS' INFO

Refat E. Amdiy, MD, Dr. Sci. (Medicine);
ORCID: 0000-0003-1305-5791; eLibrary SPIN: 2399-7041;
Scopus Author ID: 6506347944; e-mail: r.e.amdiy@mail.ru

Igor V. Kuzmin, MD, Dr. Sci. (Medicine), Professor;
ORCID: 0000-0002-7724-7832; eLibrary SPIN: 2684-4070;
Scopus Author ID: 56878681300; e-mail: kuzminigor@mail.ru

ОБ АВТОРАХ

Рефат Эльдарович Амдий, д-р мед. наук;
ORCID: 0000-0003-1305-5791; eLibrary SPIN: 2399-7041;
Scopus Author ID: 6506347944; e-mail: r.e.amdiy@mail.ru

Игорь Валентинович Кузьмин, д-р мед. наук, профессор;
ORCID: 0000-0002-7724-7832; eLibrary SPIN: 2684-4070;
Scopus Author ID: 56878681300; e-mail: kuzminigor@mail.ru