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Quality of life and functional outcomes after ileocystoplasty for microcystis of tuberculous etiology

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ABSTRACT

BACKGROUND: The outcome of tuberculous bladder lesions is its irreversible shrinkage, persistent disorder of accumulative function and a significant decline in the quality of patient's life. Supratrigonal augmentation ileocystoplasty and replacement ileocystoplasty are standard treatments for microcystis of tuberculous etiology. Currently, the advantages and disadvantages of these methods have not been sufficiently studied.

AIM: To conduct a comparative assessment of the quality of life and functional outcomes of patients with tuberculosis etiology microcystis after supratrigonal augmentation and replacement ileocystoplasty.

MATERIALS AND METHODS: The patients of the study were divided into two groups. The first group included 19 patients who underwent supratrigonal bladder resection with augmentation ileocystoplasty, the second group included 20 patients treated with replacement ileocystoplasty. In the period from one to six years after the surgery, quality of life was assessed and a complex urodynamic study was carried out.

RESULTS: Analysis of the "General health" measure according to the King's Health Questionnaire demonstrated the worst quality of life in the patient group after bladder resection ($p = 0.013$). In this group, the QoL scale indicated the worst measures of "Quality of Life due to Dysuria" ($p = 0.019$). The measures of the filling enterocystometry were consistent between the patient cohorts and varied in the satisfactory range. All key criteria reflecting the voiding function were significantly worse in group I: larger volume of residual urine ($p = 0.001$), lower maximum emptying rate ($p = 0.034$), and higher frequency of intermittent self-catheterization ($p = 0.001$). Calculation of the obstruction index showed a high prevalence of chronic urinary retention in the specified patient group ($p = 0.015$). Thus, abdominal pressure had to be increased several-fold for the patients underwent augmentation ileocystoplasty to initiate ($p = 0.001$) and maintain ($p = 0.036$) emptying of the intestinal urinary reservoir. The incidence of reservoir-ureteral reflux and incontinence is consistent in both groups ($p > 0.05$).

CONCLUSIONS: Cystectomy with replacement ileocystoplasty, as an intervention with the best quality of life and functional results, is the optimal choice in patients with microcystis of tuberculous etiology.

Keywords: urogenital tuberculosis; bladder tuberculosis; cystectomy; bladder resection; ileocystoplasty; urodynamic; quality of life.

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Качество жизни и функциональные результаты после илеоцистопластики при микроцистисе туберкулезной этиологии

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АННОТАЦИЯ

Актуальность. Исходом туберкулезного поражения мочевого пузыря является его необратимое сморщивание, стойкое нарушение накопительной функции и значительное ухудшение качества жизни больного. Супратригональная аугментационная илеоцистопластика и заместительная илеоцистопластика — стандартные виды лечения микроцистиса туберкулезной этиологии. На сегодняшний день преимущества и недостатки указанных методов изучены недостаточно.

Цель — провести сравнительную оценку качества жизни и функциональных результатов у пациентов с микроцистисом туберкулезной этиологии после супратригональной аугментационной и заместительной илеоцистопластики.

Материалы и методы. В исследовании были сформированы две группы. Первая группа включала 19 пациентов, перенесших супратригональную резекцию мочевого пузыря с аугментационной илеоцистопластикой, во вторую группу вошли 20 человек, которым выполняли заместительную илеоцистопластику. В период от 1 до 6 лет после операции изучалось качество жизни и проводилось комплексное уродинамическое исследование.

Результаты. Анализ значений «Общее состояние здоровья» согласно опроснику KHQ продемонстрировал худшее качество жизни в группе больных после резекции мочевого пузыря (p = 0,013). У них же по данным шкалы качества жизни QoL отмечался менее приемлемый результат по показателю «Качество жизни вследствие расстройств мочеиспускания» (p = 0,019). Показатели энтероцистометрии наполнения были сопоставимы между когортами пациентов и находились в удовлетворительном диапазоне. Все ключевые критерии, отражающие эвакуаторную функцию, оказались значимо хуже в первой группе: больший объем остаточной мочи (p = 0,001), меньшая максимальная скорость опорожнения (p = 0,034) и необходимость интермиттирующей самокатетеризации в большем числе случаев (p = 0,001). Расчет индекса обструкции показал широкую распространенность хронической задержки мочи среди указанной категории больных (p = 0,015). Так, участникам, перенесшим аугментационную илеоцистопластику, для инициации (p = 0,001) и поддержания (p = 0,036) опорожнения кишечного мочевого резервуара приходилось создавать в разы большее абдоминальное давление. Частота развития резервуаро-мочеточникового рефлюкса и инконтиненции была сопоставима в обеих группах (p > 0,05).

Выводы. Цистэктомия с заместительной илеоцистопластикой, как вмешательство с лучшими показателями качества жизни и функциональными результатами, является оптимальным выбором у пациентов с микроцистисом туберкулезной этиологии.

Ключевые слова: урогенитальный туберкулез; туберкулез мочевого пузыря; цистэктомия; резекция мочевого пузыря; илеоцистопластика; уродинамика; качество жизни.

Как цитировать

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BACKGROUND

According to the World Health Organization Global Report, 10.6 million people (5.8 million men, 3.5 million women, and 1.3 million children) were newly diagnosed with tuberculosis in 2022, with about 3.1 million not treated due to late diagnosis. In 2022, the disease ranked second as a cause of death from a single infectious agent, after COVID-19. Tuberculosis was the cause of death in 1.3 million patients (including 167,000 patients with HIV) and remained the main death factor for HIV-positive people [1]. Extrapulmonary forms account for 5% to 45% of cases [2–4]. On average, this value is close to 10% and tends to decrease in developed countries and increase in developing ones [5, 6]. According to the data presented on the portal of the Unified Interdepartmental Information and Statistics System (EMISS), more than 45,000 patients with newly diagnosed active tuberculosis were registered in Russia in 2022. For the period, the incidence rate per 100,000 population was 31.0. Extrapulmonary lesions accounted for 2.8% of newly diagnosed cases [7]. The most frequent localizations of extrapulmonary tuberculosis were bone tissue, urogenital tract, lymph nodes, pleura and cerebral membranes [8]. Among extrapulmonary forms, the proportion of urogenital tuberculosis varies widely depending on the geographical region: reaching 15%–20% in Africa, Asia, Eastern Europe and 2%–10% in Western Europe and the USA, and ranks second, slightly behind tuberculosis of bones and joints. In more than 20% of cases, urogenital tuberculosis occurs in patients with active pulmonary tuberculosis [8–10].

In the structure of urogenital tuberculosis, the incidence of bladder involvement is 10.6%–52.3% [5, 11–16]. Specific bladder lesions lead to irreversible reduction in its capacity and subsequent shrinking, which is manifested by persistent impairment of accumulative function and a significant decline in the quality of life [14, 17, 18]. While being effective at the initial stages of the disease, conservative therapy at this stage can no longer lead to regression of pathologic morphofunctional changes. A shrunken bladder, or microcystis, or small tuberculous bladder, or stage 4 bladder tuberculosis, is an extreme clinical form and an indication for surgery [19].

Supratrigonal bladder resection followed by augmentation ileocystoplasty (AICP) and cystectomy with replacement ileocystoplasty (RICP) are the standard and most commonly performed surgical procedures for small tuberculous bladder. These methods aim at creating a low-pressure bowel reservoir as close to a healthy bladder as possible, which can preserve upper urinary tract function and improve quality of life [11, 14, 20–25]. To date, there is no consensus on the criteria for choosing between these types of surgeries. Several authors give unambiguous preference to RICP, while another group of authors, when choosing a surgical aid, proceeds from the data on the functional capacity of the bladder, suggesting performing AICP when its values are higher than 15–20 mL, and RICP when this volume is lower. This approach is based on the hypothesis that a decrease to 15–20 mL and less is a marker of the bladder triangle involvement in the pathologic process and its preservation becomes inappropriate, also in order to avoid possible complications. However, publications justifying this assumption are in line with expert opinion by the level of evidence [14, 19, 22, 25–28].

The literature review shows that although surgery for small tuberculous bladder has no alternatives, there are currently no publications comparing the quality of life and the results of a complex urodynamic study (CUDS) after these interventions. Few papers have described the quality of life and functional outcomes after surgery for small tuberculous bladder [22, 29–34]. The use of different parts of the gastrointestinal tract, their different lengths, various ways of their reconfiguration, dissimilarity of bladder resection levels in the absence of a full range of urodynamic studies indicates the heterogeneity of the groups by a number of key parameters in these studies. This, in turn, makes it impossible to extrapolate the significance of the findings to the previously mentioned most common surgical techniques.

Thus, the pronounced and irreversible impairment of lower urinary tract function and the resulting decline in the quality of life of patients with small tuberculous bladder, as well as the lack of reasoned preferences in the choice of ileocystoplasty method determine the relevance of this study.

The study aimed to compare the quality of life and functional results in patients with microcystis of tubercular etiology after supratrigonal augmentation and replacement ileocystoplasty.

MATERIALS AND METHODS

From 2007 to 2019, more than 100 surgeries for small tuberculous bladder were performed in the Department of Urogenital Tuberculosis in the St. Petersburg Research Institute of Phthisiopulmonology. A total of 39 patients were included in this monocenter prospective study: 21 men (53.8%) and 18 women (46.2%), mean age of 55 years (21 to 76 years). Two groups were formed depending on the surgical technique. Group 1 included 19 patients who underwent supratrigonal bladder resection followed by AICP. The surgery was performed using a modified Studer technique and involved a wide anastomosis of the reservoir with the resected bladder. Group 2 included 20 patients with cystectomy and RICP using the classic Studer technique.

Patients were enrolled in the study according to the following criteria: presence of small tuberculous bladder

(functional capacity of not more than 100 mL); surgery in the scope of supratrigonal bladder resection followed by AICP or cystectomy with RICP; not less than 1 year from surgery to inclusion in the study.

Non-inclusion criteria were organic infravesical obstruction, including prostatic hyperplasia; upper urinary tract obstruction; metabolic acidosis; concomitant neurologic diseases; detrusor sphincter dyssynergia; vesicoureteral reflux; stress urinary incontinence and bladder capacity of less than 20 mL before surgery.

The groups were similar by gender, age, bladder and prostate volume ($p > 0.05$). At the time of surgery, all patients had completed anti-tuberculosis chemotherapy or its intensive phase. During the post-surgery examination, clinical recovery from tuberculosis or absence of specific process activity was confirmed in all cases.

Long-term results were followed up 1 year or more (maximum 6 years) after the surgeries, and differences in follow-up times were comparable ($p > 0.05$). The patients completed questionnaires as part of the study. The impact of lower urinary tract symptoms on quality of life was assessed using the IPSS (International Prostate Symptom Score), QoL (Quality of life due to urinary symptoms) scale and KHQ (King's Health Questionnaire). The latter focuses on both a comprehensive assessment of urinary-related quality of life and the severity of various disorders, i.e., frequency of nocturia, urgency, urinary incontinence, pain syndrome, and urinary incontinence during intercourse [35]. In addition to quality of life, questionnaires were used to record subjective assessment of the severity of lower urinary tract dysfunction. The relevant part of the KHQ questionnaire and the specialized IPSS questionnaire were used. Originally developed for patients with benign prostatic hyperplasia, the IPSS questionnaire has been widely used over time in other diseases that lead to lower urinary tract dysfunction, including in women [36]. In this regard, this questionnaire was named International Scoring System for Lower Urinary Tract Symptoms in the adapted version for the countries of the Commonwealth of Independent States [37].

Objective assessment of the functional state of the lower urinary tract was performed using a urinary diary, bladder ultrasound and CUDS. The Pico Smart SNYC0022 urodynamic system certified in Russia (Menfis biomedica, Italy) and Urocompact 6000 plus weight uroflowmeter (Wiest, Germany) were used. CUDS included residual urine volume determination, uroflowmetry, filling cystometry and pressure/flow study with pelvic electromyography. All the mentioned tests in the study were performed in line with the international requirements and guidelines of the Intestinal Reservoir Subcommittee of the Terminology Standardization Committee of the International Urinary Retention Society of 1996 [38–41].

The study was approved by the Independent Ethical Committee of St. Petersburg Research Institute of Phthisiopulmonology of the Ministry of Health of the Russian Federation (Extract No. 4.1 of April 15, 2013).

Statistical analysis of clinical data was performed using Statistica for Windows (version 12). The distribution of quantitative parameters was assessed using the Shapiro–Wilk test. They were compared in the studied groups using the Mann–Whitney test. Qualitative parameters were evaluated using nonparametric methods χ^2, χ^2 with Yates's correction (for small groups), and Fisher's test. Results are presented as the median and upper and lower quartiles, Me [Q_{25}; Q_{75}]. The criterion of statistical significance of the obtained results was considered to be $p < 0.05$.

RESULTS

Patients in both cohorts reported complete resolution of frequent urination, urgency and associated urinary incontinence, pain and discomfort associated with urge to urinate after surgery. This resulted in normalized sleep, reduced or eliminated dependence on absorbent hygiene products, and no need to plan trips based on the location of public toilets. Overall, with improvement relative to the baseline, the evaluation conducted demonstrates differences in achieved results. Thus, according to the QoL scale, the group of patients who underwent bladder resection showed a worse score on the Quality of Life due to Urinary Symptoms parameter than after cystectomy ($p = 0.019$). In the same group, according to the KHQ questionnaire, less acceptable values were recorded for General Health Status domain ($p = 0.013$). The cohorts were comparable in selected aspects of quality of life, such as the severity of limitations in daily activities and socializing, degradation of personal relationships, deterioration in sleep and energy, and overall severity of their condition (Table 1). The best domain scores for the limitations in physical activity and emotional state were found in the post-cystectomy group, but the differences were not statistically significant.

The total IPSS score of the patients in the two groups did not differ significantly, remaining in the range of 15.40–17.64, which corresponds to a moderate degree of urinary dysfunction ($p = 0.178$). A similar pattern of findings was typical of the IPSS irritative domain ($p = 0.119$). The worst value of the obstructive domain was found in Group 1, i.e., 12.29 compared to 8.50 in Group 2, but this difference was not significant ($p = 0.077$). A similar but already statistically significant difference was found when assessing the frequency of urinary difficulty based on Question 18 of the KHQ questionnaire ($p = 0.045$). No significant differences were found for other questions in this questionnaire. Thus, the questionnaire

demonstrated that the quality of life and urinary act characteristics achieved after RICP were rated higher than after AICP.

The functional capacity of the intestinal urinary reservoir (IUR), according to urinary diaries, was comparable and ranged 350 to 400 mL. The mean single voiding volume in Group 1 was 183 ± 104 mL versus 241 ± 82 mL in Group 2, but this difference was statistically insignificant (p = 0.096).

The possibility of independent IUR voiding was present in all observed patients after RICP, whereas after AICP it was completely absent in 5 cases (26.3%). Moreover, the remaining 14 patients in this group had significantly higher residual urine volume (p = 0.001). It exceeded 100 mL in 9 patients in Group 1 and only in one patient in Group 2. Thus, a significantly higher prevalence of chronic urinary retention was found among patients after AICP, 73.7% vs. 26.3%, and hence a more frequent need for intermittent self-catheterization (p = 0.001).

Uroflowmetry was performed in all patients who were able to void independently (Table 2). For four of the six parameters assessed, Group 1 had significantly worse results than Group 2. In addition to the main parameter — maximum voiding rate — less acceptable values were found for the average voiding rate, volume of excreted urine and time of delayed voiding. No differences were found for the other items.

Not all patients with IUR were able to excrete more than 120 mL of urine at a single voiding. This fact, despite the absence of generally accepted standards for performing uroflowmetry after intestinal plasty of the urinary reservoir, may cast doubt on the representativeness of the obtained values. Therefore, a comparative re-evaluation of uroflowmetry results was performed only in those patients who could achieve a volume greater than 120 mL when voiding the urinary reservoir. Only 7/14 patients from Group 1 who were able to void independently and 15/20 patients from Group 2 were included in the re-evaluation (Table 3).

Modified group data analysis continues to demonstrate better uroflowmetry results after cystectomy than after supratrigonal bladder resection. First of all, it concerns the main parameter — the maximum urine flow rate, which was within normal range and significantly higher in Group 2 patients than in Group 1 patients. A similar pattern of differences was obtained when assessing the volume of excreted urine. Group 2 showed better results for the other parameters, but due to the limited sample

Table 1. Quality of life measures according to the King's Health Questionnaire (KHQ), *Me* [Q_{25}; Q_{75}]
Таблица 1. Показатели качества жизни по опроснику KHQ, *Me* [Q_{25}; Q_{75}]

Parameter	Groups		Statistical significance, p
	Group 1	Group 2	
Domain 1. General health perception, score	2 [2; 2]	1 [1; 2]	0.013
Domain 2. Incontinence impact, score	3 [2; 3]	3 [2; 3]	0.448
Domain 3. Role limitations, score	3 [2; 3]	2 [2; 2,5]	0.160
Domain 4a. Physical limitations, score	2 [1; 4]	2 [1; 2,5]	0.148
Domain 4b. Social limitations, score	1 [1; 2]	1 [1; 1,5]	0.319
Domain 5. Personal relationships, score	1 [1; 2]	1 [1; 2]	0.884
Domain 6. Emotions, score	2 [1; 4]	1.5 [1; 2,5]	0.164
Domain 7. Sleep/energy, score	2 [1; 3]	2 [1,5; 2]	0.811
Domain 8. Severity measures, score	1 [1; 3]	2 [1; 3]	0.527

Table 2. Evaluation of uroflowmetry data, *Me* [Q_{25}; Q_{75}]
Таблица 2. Оценка показателей урофлоуметрии, *Me* [Q_{25}; Q_{75}]

Uroflowmetric parameter	Groups		Statistical significance, p
	Group 1 (n = 14)	Group 2 (n = 20)	
Maximum urine flow rate, mL/s	8.4 [5.2; 13.0]	16.0 [12.4; 20.7]	0.002
Average urine flow rate, mL/s	3.05 [2.1; 5.1]	6.25 [4.4; 9.7]	0.002
Time to maximum rate, s	8.6 [4.6; 10.5]	10.5 [7.6; 15.2]	0.111
Urination time, s	38.3 [23.0; 104.0]	39.5 [24.7; 49.1]	0.506
Volume of excreted urine, mL	98.0 [56.0; 176.0]	219.0 [124.0; 311.0]	0.007
Urinary retention time, s	9.85 [2.6; 17.8]	2.0 [1.5; 6.0]	0.048

Table 3. The uroflowmetry findings with a volume of emptying more than 120 ml, *Me* [Q_{25}; Q_{75}]
Таблица 3. Результаты урофлоуметрии при объеме опорожнения более 120 мл, *Me* [Q_{25}; Q_{75}]

Uroflowmetric parameter	Groups		Statistical significance, *p*
	Group 1 (*n* = 7)	Group 2 (*n* = 15)	
Maximum urine flow rate, mL/s	13.0 [8.8; 14.9]	17.9 [13.1; 23.8]	0.034
Average urine flow rate, mL/s	5.1 [2.2; 7]	6.6 [5.7; 10.9]	0.105
Time to maximum rate, s	8.5 [3.3; 14.9]	11.0 [8.3; 17.5]	0.245
Voiding time, s	27.8 [19.9; 172]	41.0 [30.1; 62]	0.916
Volume of excreted urine, mL	176.0 [131; 214]	277.0 [188; 357]	0.041
Voiding retention time, s	2.6 [0; 14]	2.0 [1; 3]	0.622

Table 4. The filling enterocystometry measures, *Me* [Q_{25}; Q_{75}]
Таблица 4. Показатели энтероцистометрии наполнения, *Me* [Q_{25}; Q_{75}]

Uroflowmetric parameter	Groups		Statistical significance, *p*
	Group 1	Group 2	
Reservoir capacity at first urge, mL	137.0 [81; 222.0]	146.5 [98.5; 180.0]	0.933
Reservoir capacity at normal urge, mL	269.0 [165.0; 358.0]	190.0 [152.5; 247.5]	0.070
Reservoir capacity at strong urge, mL	326.0 [258.0; 497.0]	239.5 [191.5; 332.5]	0.062
Maximum enterocystometric capacity, mL	344.0 [278.0; 497.0]	252.5 [193.0; 395.5]	0.070
Estimated reservoir pressure at first urge, cm of water column	3.9 [0.8; 9.4]	8.95 [2.2; 17.3]	0.177
Estimated reservoir pressure at normal urge, cm of water column	6.8 [2.9; 21.1]	12.25 [7.6; 25.9]	0.211
Estimated reservoir pressure at strong urge, cm of water column	15.3 [7.2; 44.6]	26.65 [11.2; 41.0]	0.369
Estimated reservoir pressure at maximum enterocystometric capacity, cm of water column	18.5 [10.5; 44.0]	26.65 [11.1; 37.0]	0.474
Compliance, mL/cm of water column	18.5 [13.4; 36.3]	14.54 [10.5; 33.7]	0.369
Number of patients with involuntary contractions of the reservoir wall	12.0 (63.16 %)	13.0 (65.0 %)	>0.05
Number of involuntary contractions of the reservoir wall	2.5 [1.5; 3.5]	4.0 [3.0; 7.0]	0.092
Maximum estimated reservoir pressure at involuntary contraction of the reservoir wall, cm of water column	35.5 [23.9; 62.0]	44.0 [27.0; 72.0]	0.624

size, after excluding a large proportion of patients from the analysis, these differences did not become statistically significant.

The primary method of assessing reservoir function of both bladder and IUR is filling cystometry. For all volumetric parameters of enterocystometry, such as reservoir capacity at first, normal and strong urges, and maximum enterocystometric capacity, no statistically significant differences were obtained. Despite this, all four volumetric parameters of filling enterocystometry were greater in Group 1, and the differences were trending in three of them. The calculated reservoir pressures at the first, normal, strong urges and at maximum enterocystometric capacity were also comparable (Table 4).

The peculiarities of the plastic material used to form the IUR determine the need to take into account the peristaltic activity, since it can play a destabilizing role in recreating a low-pressure reservoir. The indicated IUR activity was recorded in 63.16% of Group 1 patients and 65.0% of Group 2 patients. In addition, no statistically significant differences were obtained when estimating the number of involuntary peristaltic contractions of the IUR wall and the maximum estimated reservoir pressure during them. The latter was in an acceptable range in most cases. The IUR wall compliance in both groups remained within the acceptable range and, which is equally important, was comparable.

Voiding enterocystometry with pelvic electromyography was performed in all patients with independent IUR voiding (Table 5). Involuntary electromyographic activity was not detected in any of the cases.

The estimated reservoir opening pressure values were not significantly different between groups when

Table 5. Emptying enterocystometry data
Таблица 5. Данные энтероцистометрии опорожнения

Uroflowmetric parameter	Groups		Statistical significance. *p*
	Group 1	Group 2	
Estimated reservoir opening pressure, cm of water column	22.6 [20.0; 42.0]	25.3 [15.2; 37.6]	0.847
Abdominal opening pressure, cm of water column	30.2 [21.2; 43.3]	5.5 [0.0; 18.0]	0.001
Opening time based on calculated reservoir pressure, s	18.2 [4.5; 115.8]	4.8 [1.0; 18.2]	0.107
Opening time based on abdominal pressure, s	21.1 [11.4; 131.2]	8.0 [4.3; 30.5]	0.077
Estimated reservoir pressure at maximum voiding rate, cm of water column	24.4 [17.1; 32.1]	24.2 [10.3; 36.1]	0.600
Abdominal pressure at maximum voiding rate, cm of water column	29.5 [6.0; 50.3]	11.4 [0.6; 20.0]	0.036

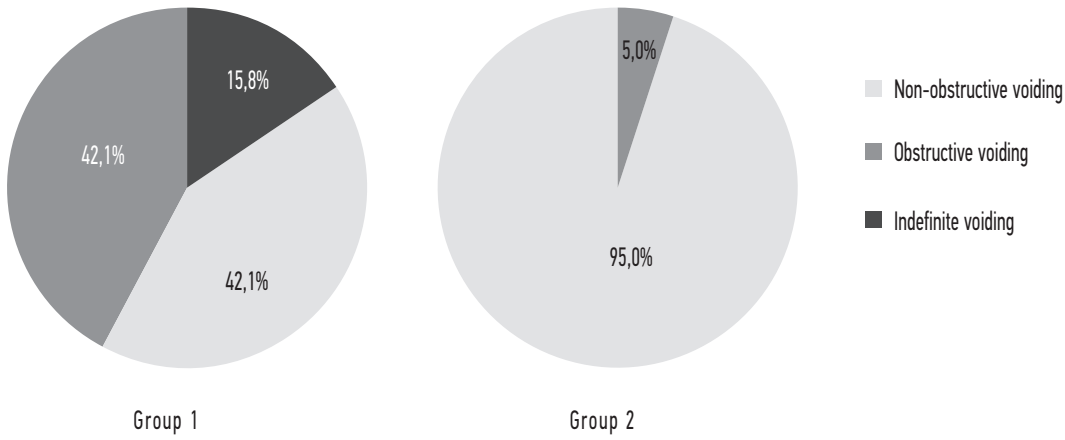

Figure. The distribution structure for the types of the intestinal urinary reservoir emptying in patients of groups 1 and 2; $p = 0.015$
Рисунок. Структура распределения типов опорожнения кишечного мочевого резервуара у пациентов групп 1 и 2; $p = 0{,}015$

compared with abdominal pressure at this point. It was much higher in Group 1 patients, and the differences were statistically significant. In addition to the opening pressure, all patients in this group had large opening times, which were outside the acceptable range, whereas in Group 2 the values corresponding to normal ones prevailed. Due to the wide variation in the obtained data, the seemingly obvious differences were characterized only by a trend toward statistical significance.

The estimated reservoir pressure at maximum voiding rate, as well as the estimated reservoir opening pressure, were comparable between groups. Comparison of abdominal pressures at maximum voiding rate continues to demonstrate a multiple of higher pressure in Group 1, the differences were statistically significant.

The obstruction index was calculated according to the Abrams-Griffiths method, where the equivalent detrusor pressure at maximum voiding rate is naturally the estimated reservoir pressure. The obtained obstruction index allowed dividing the patients within each group by the type of voiding of the intestinal urinary reservoir into three subgroups: obstructive, nonobstructive, and indefinite (see Figure). The presented parameters show statistically significant differences between the groups. Thus, the obstructive type of voiding was detected in almost half of the patients after AICP, while only in one case in the other group (5%).

Taking into account the leading role of abdominal pressure in the IUR voiding, we recalculated the obstruction index according to the Abrams-Griffiths method based on the abdominal pressure at the maximum voiding rate. The obtained results do not contradict the initial calculations and also demonstrate statistically significant differences between the groups ($p = 0.001$). Non-obstructive voiding was registered in all patients after RICP, whereas only in 42.1% of cases after AICP. The latter group was otherwise represented by patients with both obstructive (36.8%) and indefinite (21.1%) voiding patterns. No stress urinary incontinence was observed in any of the patients. In all cases, there was so-called overflow incontinence, which occurred most often during nocturnal sleep. In Group 1, this sign was recorded less frequently, but the difference significance was not established ($p > 0.05$). The incidence of reservoir

ureteral reflux was comparable in both groups, accounting for 42.1 and 45.0% ($p > 0.05$). Despite preservation of the urethral triangle, as well as the ureteral orifices, Group 1 patients did not show a beneficial lower incidence of reservoir ureteral reflux.

DISCUSSION

According to the KHQ questionnaire, patients undergoing bladder resection with AICP have a significantly worse score in the General Health domain, with no intergroup differences in the Impact of Urinary Disorders on Life domain. This may suggest that the score in the General Health domain after AICP is reduced not due to impaired voiding function, but possibly due to other comorbidities. However, this assumption is refuted by the QoL score, which shows a significantly worse score in the Urinary Symptoms domain of Quality of Life after AICP. This contradiction, in our opinion, is caused by the shift of emphasis in the question in the KHQ questionnaire from the emotional status to the functional-role aspect of the quality of life as follows: "How much do you think your bladder problem affects your life?" The QoL questionnaire has a fundamentally different question: "How would you feel if you had to live with your urinary condition the way it is now for the rest of your life?" Thanks to the ability to perform self-catheterization, patients with impaired evacuatory function may not have to limit their physical and social activities or avoid going to public places. However, the prospect of persistent urinary difficulty and the realization of the need to continually (for the rest of life) perform self-catheterization, which involves a significant amount of resources, energy, time and possible complications, negatively affects self-perception and ultimately quality of life, as demonstrated by the QoL scale. The significant role of this factor is also confirmed by the absence of intergroup differences in functional-role aspects of the quality of life (Table 1).

Subjective assessment of lower urinary tract function, based on the IPSS questionnaire and the corresponding section of the KHQ questionnaire, reveals comparable parameters reflecting reservoir function and a higher prevalence of obstructive symptoms in the first group. Clear evidence of this is the large proportion of patients after AICP who reported their inability to empty the IUR on their own.

Objective control data support the subjective assessment. The urinary diary values and filling enterocystometry were comparable, and more importantly, remained within the acceptable range. This demonstrates the achievement of satisfactory reservoir function in both groups. In contrast to reservoir function, analysis of evacuatory function parameters shows significant differences. Significantly greater residual urine volume and consequent more frequent need to perform intermittent self-catheterization were typical of the group after AICP. Significantly worse uroflowmetry values were also noted here. All of the above findings indicate impaired evacuatory function, but do not reveal its mechanism. In this regard, all patients with the ability of independent IUR voiding were performed voiding enterocystometry followed by calculation of the obstruction index using the Abrams-Griffiths method. The results indicate a comparable contribution of the IUR wall to the voiding process, but due to the lower maximum velocity in Group 1, the obstruction index was significantly more often in the obstructive range. This fact, as well as literature data, casts doubt on the validity of using calculated reservoir pressure in the assessment of infravesical obstruction [42]. It is known that patients with intestinal urinary reservoirs are a priori largely transferred to the abdominal voiding, which is due to weak and uncontrolled contractile capacity of the IUR wall. Thus, the main mechanism for triggering the voiding process is abdominal pressure [42–52]. This shows that its significance in interpreting the voiding enterocystometry results is equivalent to detrusor pressure in the preserved bladder muscle layer and the significance of abdominal pressure in the case of detrusor decompensation. In turn, this allows for a directly proportional relationship between the magnitude of abdominal pressure during emptying of the intestinal urinary reservoir and the severity of infravesical obstruction. Taking this into account, several authors suggest using the abdominal pressure index to calculate the obstruction index [53, 54].

In this study, according to the abdominal pressure, both for opening and the maximum voiding rate, the patients of Group 1 had to exert many times more force not only to initiate the IUR voiding, but also to maintain it. The calculation of the obstruction index based on abdominal pressure continues to demonstrate the high prevalence of infravesical obstruction in Group 1 patients. All of the above demonstrates unsatisfactory evacuatory function of IUR after AICP due to infravesical obstruction. A direct causal relationship of obstructive urination and chronic urinary retention with a preserved urethral triangle has been demonstrated in several other studies [11, 32, 33, 55–59]. On the other hand, in this study, the mentioned relationship is not only stated but also confirmed by the CUDS. An additional argument confirming the key role of the preserved urethral triangle in evacuatory dysfunction and the development of chronic urinary retention was the follow-up and treatment outcomes: 9 (50%) patients from Group 1 underwent repeat surgery. Transurethral resection of the bladder neck was performed in 8 cases, and open resection of the remaining bladder tissue with subsequent formation of a reservoir-urethral anastomosis was performed in one case. Histology confirmed severe fibrosis in all patients, and satisfactory voiding without chronic urinary retention was restored in 7 of 9 cases.

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Despite preservation of the urethral triangle, patients in Group 1 did not show a lower incidence of reservoir ureteral reflux. None of the patients had stress urinary incontinence, all cases showed overflow incontinence, which occurred most often during nocturnal sleep. In Group 1, this sign was recorded less frequently, but the differences were only trends. The absence of stress urinary incontinence in all study patients confirms the self-sufficiency of the urethral external sphincter in providing stress urinary retention and refutes the critical importance of urethral triangle preservation for this purpose. At the same time, the continence mechanisms are not crucial for the prevention of nocturnal incontinence, as this pathology occurs as a result of the IUR overfilling, usually when the structures providing urinary retention are in good condition. Therefore, we consider the better rates of nocturnal incontinence in Group 1 with similar data on stress urinary incontinence to be a consequence of hypercontinence recorded in this group, which, in our opinion, is not subject to positive evaluation.

Thus, the hypothesis put forward earlier that the initial bladder capacity of more than 15–20 mL determines the preservation of bladder neck structures and, consequently, its functional consistency, was not confirmed in our study. This assumption, corresponding to the expert opinion by the level of evidence, ignores the factors of inevitable disintegration of the functionally unified neuromuscular apparatus structures of the bladder during its resection and subsequent scarring. Moreover, the assumed stage of fibrosis spread in the bladder wall is also questioned from the point of view of the course of tuberculosis in the urinary tract: the main gateway of infection is the ureters, and the earliest signs of the specific process are found around their mouths, hence, in the area of the urethral triangle or close to it [9, 19, 31]. According to some authors, long-term inflammatory process of the bladder wall of tubercular etiology causes its fibrosis and stiffness, which in the long term can lead to anastomosis strictures, sclerosis of its neck, hypercontinence [11, 25, 27]. Furthermore, despite ongoing antituberculosis chemotherapy, there is still a risk of recurrence of tuberculous infection in the remaining bladder wall [60].

CONCLUSION

Supratrigonal bladder resection with augmentation ileocystoplasty in contrast to cystectomy with replacement ileocystoplasty in microcystis of tubercular etiology is associated with worse quality of life and unsatisfactory evacuatory function of the intestinal urinary reservoir. This study did not show any advantages of supratrigonal resection over cystectomy in terms of quality of life or functional outcomes. The obtained results allow considering cystectomy with replacement ileocystoplasty as the surgery of choice in microcystis of tubercular etiology.

ADDITIONAL INFO

Authors' contribution. 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. Personal contribution of each author: K.Kh. Chibirov — concept and design development; literature review, collecting and preparation of samples, data analysis, writing the main part of the text; V.V. Protoshchak, P.A. Babkin, N.P.Kushnirenko — concept and design development; data analysis, editing the text of the manuscript; A.A. Gorelova, M.V. Paronnikov — preparation of samples, data analysis, writing the main part of the text.

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ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией. Личный вклад каждого автора: К.Х. Чибиров — разработка концепции и дизайна исследования, обзор литературы, сбор и обработка материала, анализ полученных данных, написание текста рукописи; В.В. Протощак, П.А. Бабакин, Н.П. Кушниренко — разработка концепции и дизайна исследования, анализ полученных данных, редактирование текста рукописи; А.А. Горелова, М.В. Паронников — обработка материала, анализ полученных данных, написание текста рукописи.

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