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Combined laparoscopic nephroureterectomy with transurethral approach to the ureter in renal tuberculosis treatment

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ABSTRACT

BACKGROUND: Tuberculosis of the genitourinary system is a common cause of organ removal surgeries. Despite the improvement of medical technologies, kidney and urinary tract surgeries for urogenital tuberculosis are traditionally performed using the open method.

AIM: To assess the findings of laparoscopic and open combined nephroureterectomy with transurethral resection of the distal ureter in patients with renal tuberculosis.

MATERIALS AND METHODS: The findings of 61 nephroureterectomies with transurethral resection of the distal ureter performed for destructive renal tuberculosis were analyzed. Open nephroureterectomy was performed in 31 patients, and laparoscopic approach was used in 30 patients. Patients in both groups were comparable by gender and age.

RESULTS: The surgery duration, volume of intraoperative blood loss, rate and severity of postoperative complications were lower in patients who had laparoscopic interventions. When examined 1 month after surgery, patients in both groups showed the improvement of clinical parameters. The following changes were reported: a significant decrease in the nighttime urination rate, a decrease in IPSS scores, and an increase in the functional bladder capacity without significant differences depending on the surgical approach. After the surgery, a significant improvement in the quality of patients' life was observed. In patients who had laparoscopic surgery, improvements were detected in all the SF-36 questionnaire domains. However, in patients after open surgery with a positive effect on most of assessed parameters no significant improvement of parameters in section "General Physical Health" was found.

CONCLUSIONS: Irrespective of the selected approach, combined nephroureterectomy with transurethral resection of the distal ureter is an effective method of surgical treatment of patients with destructive renal tuberculosis. Moreover, the laparoscopic technique has shown a number of significant advantages over open surgery.

Keywords: nephrectomy; nephroureterectomy; renal tuberculosis; ureteral resection; SF-36.

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Комбинированная лапароскопическая нефроуретерэктомия с трансуретральным доступом к мочеточнику в лечении нефротуберкулеза

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АННОТАЦИЯ

Актуальность. Туберкулез мочеполовой системы является частой причиной органоуносящих операций. Несмотря на совершенствование медицинских технологий, операции на почках и мочевыводящих путях при урогенитальном туберкулезе традиционно осуществляют открытым способом.

Цель — оценить результаты лапароскопической и открытой комбинированной нефроуретерэктомии с трансуретральной резекцией дистального отдела мочеточника у больных нефротуберкулезом.

Материалы и методы. Проведен анализ результатов 61 нефроуретерэктомии с трансуретральной резекцией дистального отдела мочеточника, выполненных по поводу деструктивного нефротуберкулеза. Нефроуретерэктомию открытым доступом выполняли 31 пациенту, лапароскопическим доступом — 30. Больные обеих групп были сопоставимы по полу и возрасту.

Результаты. Продолжительность оперативного вмешательства, объем интраоперационной кровопотери, частота и выраженность послеоперационных осложнений были ниже у пациентов, которым выполняли лапароскопические вмешательства. При обследовании через 1 мес. после операции у пациентов обеих групп выявлена положительная динамика клинических показателей. Отмечено достоверное снижение частоты ночных мочеиспусканий, уменьшение суммы баллов IPSS, увеличение функциональной емкости мочевого пузыря без существенных различий в зависимости от оперативного доступа. После операции отмечено существенное улучшение качества жизни пациентов. У больных, которым выполняли лапароскопическую операцию, выявлена положительная динамика по всем доменам опросника SF-36. В то же время у пациентов после открытой операции при положительном влиянии на большинство оцениваемых показателей не установлено значимой динамики показателей раздела «Общий физический компонент здоровья».

Выводы. Вне зависимости от выбранного доступа комбинированная нефроуретерэктомия с трансуретральной резекцией дистального отдела мочеточника является эффективным методом хирургического лечения больных деструктивным нефротуберкулезом. При этом лапароскопическая методика показала ряд существенных преимуществ перед открытым оперативным вмешательством.

Ключевые слова: нефрэктомия; нефроуретерэктомия; нефротуберкулез; резекция мочеточника; SF-36.

Как цитировать

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BACKGROUND

In most regions of Russia, genitourinary involvement is the most common form of extrapulmonary tuberculosis. Up to 80% of those affected by kidney tuberculosis undergo surgical treatment, which predominantly includes organ removal surgeries. Disease progression leads to a decrease in kidney function and the development of renal failure. Nephrectomy is not only required due to renal failure that follows the progression of specific inflammation and major calcification, but also high incidence of ureter involvement, as well as hydronephrotic changes [1, 2]. In the latter case nephroureterectomy has to be performed to fully remove the affected parts from the urinary system, prevent dysuria, empyemas, malignization, and stone formation in the ureteral stump, which occur frequently [3, 4]. However, surgery does not always reduce the disease symptoms. For example, frequent and painful urination persists in more than half of patients after nephrectomy, despite the removal of the specific infection site. It could be the result of the ureteral stump that was affected by tuberculosis still causing abnormal urinary urges [2]. It has been noted that nephroureterectomy with transurethral access to ureter in comparison to the classic nephrectomy relieves dysuria in patients with kidney tuberculosis to a larger extent [5].

The removal of the nonfunctional kidney after chemotherapy usually leads to clinical cure, but when performed through an open surgical access, it is an invasive intervention. Despite the progress in medical technology, which has significantly reduced intervention invasiveness in many areas of surgery, in the treatment of urinary tuberculosis, kidney and urinary tract surgery is carried out with the conventional open method [6]. Only a small series of cases were published that were dedicated to the results and capabilities of laparoscopic nephroureterectomy for nonfunctional kidney affected by tuberculosis [7, 8]. To this day, the effectiveness and safety of kidney and ureter removal using less invasive methods have not been studied.

The study aim is to compare the results of laparoscopic and open combined nephroureterectomy with transurethral resection (TUR) of the distal ureter in patients with renal tuberculosis.

MATERIALS AND METHODS

Between November 2017 and October 2023, 61 nephroureterectomies were carried out for destructive renal tuberculosis in Moscow Municipal Applied Research Center for Combating Tuberculosis. Thirty-one of them were performed with open access (Group 1) and 30 with laparoscopic access (Group 2). The surgery for both groups started with the TUR of the distal ureter.

Pre-operative cystoscopy showed that no patient had specific inflammation of the urinary bladder. Patients in both groups were matched in gender and age. Group 1 included 17 men and 14 women (mean age: 52.5 ± 0.5 years). Group 2 included 18 men and 12 women (mean age: 51.2 ± 7.07 years). At the time of the surgery, all patients had received the intensive phase of the main round of tuberculosis chemotherapy. The left kidney was more often affected by tuberculosis. It was true for 18 (58.1%) patients in Group 1 and 17 (56.7%) patients in Group 2. The analysis of the changes in laboratory findings for all patients was similar without significant differences between the groups.

Open nephroureterectomy with transurethral resection of the distal ureter

Group 1 patients received open combined nephroureterectomy. The surgery started with transurethral resection of the distal ureter on the side of the affected kidney. A cystoresectoscope (Karl Storz, Germany) equipped with needle electrode (Turner–Warwick loop) was used, with monopolar energy 1 cm away from the ureter opening. When vessels in the adipose tissue were bleeding, they were coagulated. The resulting 2.0 cm defect of the urinary bladder was left open, and the urinary bladder was drained with a urinary catheter for 5–6 days. After finishing the endoscopic phase, the patient's position was changed to perform lumbotomy, and the kidney with the dissected ureter were removed with open access as a single unit.

Laparoscopic nephroureterectomy with transurethral resection of the distal ureter

After the transurethral stage (same as described above), the patient was placed on their side opposite to the affected kidney. The first of 12 mm trocars was placed in the right iliac region 8 cm below the umbilicus following the midclavicular line under visual and tactile control (Hassan's technique). The second trocar was placed under optical control following the paraumbilical line to the right, 2 cm above umbilicus, and the third one was placed 2 cm below the rib following the midclavicular line. When removing the right kidney, an additional 5 mm trocar was inserted 1.5 cm below the xiphoid process to retract the liver. Using bipolar coagulation, parietal peritoneum membrane was cut along the lateral canal laterally to the descending or ascending colon in the projection of the kidney. Gerota's fascia was cut. Renal vessels were dissected followed by their clipping and transection. The kidney with the ureter was isolated from the surrounding tissue and removed through superior median access using cranial pull.

Before the surgical treatment, all patients underwent an examination, which included clinical laboratory, radionuclide, radiologic, ultrasound, endoscopic, and

morphological examination. After extensive collection of medical history and patient complaints, the patients filled out the following surveys: International Prostate Symptom Score (IPSS) and Quality of Life (QoL). Functional urinary bladder capacity was registered through bladder diary, which included urination frequency and the amount of excreted urine. The patients filled out SF36 (Health Status Survey), which is considered to be the gold standard in determining the quality of life. It contains 36 questions that quantitatively assess the health-associated quality of life [9]. The surveys were filled out before and 1 month after the surgical treatment.

Microsoft Excel was used for the statistical analysis of the resulting data. The Wilcoxon test, Mann–Whitney *U*-test, and chi-squared test were used. Minimum (min), maximum (max), mean values (*M*), median values (*Me*), standard deviation (σ), and lower and upper quartiles [*Q*_L; *Q*_U] were calculated. The differences were considered statistically significant with *p* < 0.05.

RESULTS

Based on the results of the study, the surgery duration and the intraoperative blood loss were significantly lower in patients who had laparoscopic interventions (Group 2). Those patients were also quicker to return to activity, and the duration of wound draining was significantly shorter for them than for those undergoing open surgery in Group 1 (Table 1).

The frequency and severity of postoperative complications was significantly higher in Group 1 patients when compared to Group 2 patients (see Fig.). For those who underwent open surgery, the incidence of Grade IIIa and Grade IIIb complications according to the Clavien–Dindo classification was 64.6%. For the patients who underwent laparoscopic surgeries the parameter was 10%.

During an examination 1 month after the surgical intervention, patients from both groups were found to state fewer complaints about pain in the lumbar region, general weakness, hypertension, as well as dysuria (Table 2). Statistically significant difference was found only in the frequency of pain in the lumbar region. Group 2 patients experienced it less often than Group 1 patients.

During an examination after the surgery, improvements in clinical parameters were found in patients from both groups (Table 3). Less frequent urination at night, a reduced IPSS and QoL score, and an increase in the functional urinary bladder capacity were evidenced. No significant differences were found in the extent of change in these parameters based on the surgery access type.

After surgical treatment, a significant increase in the quality of life was found. The overall estimate of the quality of life increased in Group 1 and Group 2 patients by an almost identical score: 12.2% and 12.9% respectively. Moreover, Group 2 patients, who had laparoscopic surgery, demonstrated improvements in all domains of SF36. However, Group 1 patients, who underwent open surgery, also showed significant positive changes in most

Table 1. Perioperative parameters for the patients of groups 1 and 2 (n = 61), Me [Q_L; Q_U]

Таблица 1. Периперационные показатели пациентов групп 1 и 2 (n = 61), Me [Q_L; Q_U]

Parameter	Group 1 (n = 31)	Group 2 (n = 30)	<i>p</i>
Surgery duration, min	118.00 [111.50; 128.00]	90.00 [80.00; 95.00]	<0.0001
Blood loss, mL	372.00 [360.00; 380.00]	50.00 [50.00; 100.00]	<0.0001
Patient return to activity time, days	3.00 [2.00; 4.00]	1.00 [1.00; 1.75]	<0.0001
Wound draining duration, days	3.00 [3.00; 3.00]	1.00 [1.00; 1.00]	<0.0001

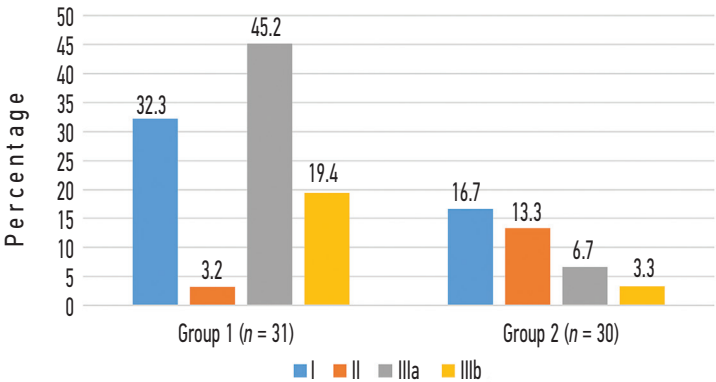


Figure. Frequency of complications in patients of groups 1 and 2. I, II, IIIa, IIIb are the grades according to the Clavien–Dindo classification
Рисунок. Частота осложнений у пациентов групп 1 и 2. I, II, IIIa, IIIb — степень осложнений по классификации Clavien–Dindo

Table 2. The rate of clinical manifestations in patients of groups 1 and 2 before and after surgery ($n = 61$)**Таблица 2.** Частота клинических проявлений у пациентов групп 1 и 2 до и после операции ($n = 61$)

Parameter	Assessment period	Group 1 ($n = 31$)	Group 2 ($n = 30$)
Pain in the lumbar region	Before surgery	23 (74.3%)	22 (73.3%)
	After surgery	19 (61.3%)	8 (26.7%)*
General weakness	Before surgery	14 (45.3%)	17 (56.7%)
	After surgery	9 (29.0%)	7 (23.3%)
Hypertension	Before surgery	8 (25.8%)	8 (26.7%)
	After surgery	6 (19.4%)	4 (13.3%)
Frequent urination	Before surgery	31 (100.0%)	27 (90.0%)
	After surgery	10 (32.3%)	7 (23.3%)
Painful urination	Before surgery	15 (48.4%)	13 (43.3%)
	After surgery	2 (6.5%)	1 (3.3%)
Urgent urination	Before surgery	11 (35.5%)	10 (33.3%)
	After surgery	6 (19.6%)	3 (10.0%)
Urge urinary incontinence	Before surgery	6 (19.6%)	6 (20.0%)
	After surgery	1 (3.2%)	1 (3.3%)

*The difference in the sign rate compared to group 1 is significant ($p < 0.05$).*Различие в частоте признака по сравнению с группой 1 достоверно ($p < 0,05$).**Table 3.** The rate of clinical parameters in patients of groups 1 and 2 before and after surgery ($n = 61$), $M \pm \sigma$ **Таблица 3.** Динамика клинических показателей у пациентов групп 1 и 2 до и после операции ($n = 61$), $M \pm \sigma$

Parameter	Assessment period	Group 1 ($n = 31$)	Group 2 ($n = 30$)
Frequency of urination at night	Before surgery	4.0 ± 1.0	3.4 ± 0.9
	After surgery	$1.6 \pm 0.5^*$	$1.3 \pm 0.4^*$
International Prostate Symptom Score (IPSS), points	Before surgery	15.8 ± 1.9	13.7 ± 2.3
	After surgery	$7.8 \pm 0.9^*$	$7.8 \pm 1.1^*$
Quality of Life, score	Before surgery	3.4 ± 0.5	3.8 ± 0.8
	After surgery	$1.7 \pm 0.5^*$	$1.9 \pm 0.5^*$
Functional urinary bladder capacity, mL	Before surgery	187.1 ± 22.2	180.0 ± 24.9
	After surgery	$298.4 \pm 32.9^*$	$296.7 \pm 29.2^*$

*The difference with the preoperative value is significant ($p < 0.05$).*Различие со значением до операции достоверно ($p < 0,05$).

Table 4. The assessment of the quality of patients' life using the SF-36 questionnaire before and after surgery ($n = 61$), $Me [Q_L; Q_U]$, score
Таблица 4. Оценка качества жизни пациентов по опроснику SF-36 до и после операции ($n = 61$), $Me [Q_L; Q_U]$, балл

SF 36 Domain	Assessment period	Group 1 ($n = 31$)	Group 2 ($n = 30$)
Physical Functioning (PF)	Before surgery	67.3 [63.9; 71.0]	67.7 [64.2; 71.0]
	After surgery	72.8 [70.5; 77.0]*	79.9 [75.1; 82.2]**
	Changes over time	+8.3%	+18.1%
Role-physical (RP)	Before surgery	44.2 [28.6; 64.5]	41.7 [38.5; 46.9]
	After surgery	88.8 [78.7; 103.1]**	84.1 [82.6; 85.6]**
	Changes over time	+101.07%	+101.6%
Bodily pain (BP)	Before surgery	37.7 [33.9; 39.6]	36.5 [34.2; 39.1]
	After surgery	61.1 [58.2; 63.0]**	28.8 [26.6; 30.2]**
	Changes over time	+61.9%	+21.2%
General health (GH)	Before surgery	55.7 [50.9; 60.5]	55.7 [50.9; 60.6]
	After surgery	70.3 [68.6; 72.8]**	77.0 [76.1; 78.5]**
	Changes over time	+26.3%	+38.3%
Vitality (VT)	Before surgery	38.7 [36.6; 41.1]	38.8 [35.4; 42.9]
	After surgery	44.0 [42.3; 45.6]*	52.8 [50.5; 54.9]**
	Changes over time	+13.9%	+35.9%
Social functioning (SF)	Before surgery	52.3 [47.5; 55.7]	51.3 [46.8; 54.7]
	After surgery	86.3 [82.9; 90.3]**	90.0 [88.8; 91.3]**
	Changes over time	+65.2%	+75.4%
Role-emotional (RE)	Before surgery	56.4 [55.1; 59.3]	57.5 [53.8; 59.7]
	After surgery	78.9 [74.2; 86.6]**	79.0 [74.4; 82.7]**
	Changes over time	+40.0%	+37.4%
Mental health (MH)	Before surgery	40.7 [37.6; 43.7]	41.0 [38.2; 42.8]
	After surgery	50.1 [48.1; 52.6]**	49.9 [48.3; 53.0]**
	Changes over time	+23.2%	+21.7%
Physical health (PH)	Before surgery	47.1 [46.6; 47.8]	47.3 [46.7; 47.8]
	After surgery	49.5 [49.0; 49.9]	50.2 [50.1; 50.4]**
	Changes over time	+5.0%	+6.2%
Overall health	Before surgery	88.0 [85.0; 90.6]	88.7 [85.7; 90.3]
	After surgery	98.7 [96.0; 101.2]**	100.1 [98.4; 103.09]**
	Changes over time	+12.2%	+12.9%

*The difference with preoperative value is significant ($p = 0.0002$); **The difference with preoperative value is significant ($p < 0.0001$).
*Различие со значением до операции достоверно ($p = 0,0002$); **различие со значением до операции достоверно ($p < 0,0001$).

evaluated parameters, no significant changes in the total score of the Physical Health section were found (Table 4).

CONCLUSION

Combined nephroureterectomy is an effective method of surgical treatment of destructive forms of renal tuberculosis. Regardless of the selected surgery technique, a significant improvement in clinical parameters is found after it, including a reduction in the lower urinary tract

symptoms and an increase in the patients' quality of life. Laparoscopic access has a number of advantages in comparison to open surgery. They include reduced duration of the surgical intervention, lower blood loss, lower frequency and severity of postoperative complications, faster return to activity and recovery in patients when compared to open surgery. The laparoscopic method shows a more pronounced positive effect on patients' quality of life, including a more significant improvement in both psychological and physical components of quality of life.

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: O.N. Zuban — concept and design of the study, performing surgical operations, analysis of the data obtained, editing the text of the manuscript; M.A. Prokopovich — performing surgical operations, literature data analysis, analysis of the data obtained, writing the text of the manuscript; D.A. Vishnevskii — analysis of the data obtained, writing the text of the manuscript; R.M. Chotchaev — performing surgical operations, analysis of the data obtained; E.M. Bogorodskaya — analysis of the data obtained, editing the text of the manuscript, approval of the final version of the article; M.P. Korchagin — literature data analysis, analysis of the data obtained.

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

Ethics approval. All patients gave written informed consent to participate in the study and publication of the obtained data in scientific journals.

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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: О.Н. Зубань — концепция и дизайн исследования, выполнение хирургических вмешательств, анализ полученных данных, редактирование текста рукописи; М.А. Прокопович — выполнение хирургических вмешательств, анализ данных литературы, анализ полученных данных, написание текста рукописи; Д.А. Вишневский — анализ полученных данных, написание текста рукописи; Р.М. Чотчаев — выполнение хирургических вмешательств, анализ полученных данных; Е.М. Богородская — анализ полученных данных, редактирование рукописи, утверждение окончательного варианта статьи; М.П. Корчагин — анализ данных литературы, анализ полученных данных.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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