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Analysis of the experience of robot-assisted cystectomy with various types of urine derivation

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ABSTRACT

BACKGROUND: Radical cystectomy is the main treatment for patients with muscle-invasive bladder cancer. Robot-assisted operations have become increasingly widespread; thus, an analysis of the results of using this technique is required.

AIM: To analyze our experience with robot-assisted radical cystectomy with different types of urinary diversion and compare the results to those obtained by other centers.

MATERIALS AND METHODS: The treatment results of 23 patients who underwent robot-assisted cystectomy with various types of urine derivation for bladder cancer between 2021 and 2024 were retrospectively analyzed.

RESULTS: Patients who had the Studer urinary reservoir formed were slightly younger and had better functional status and a higher body mass index. Additionally, there were more patients of the very high-risk cT1 stage. In patients who underwent ureterocutaneostomy, stages sT3–4 were more common. The average duration of the operation was 418.2 minutes. The longest duration (533.5 minutes) was observed during the formation of the urinary reservoir and the shortest (294.3 minutes) during ureterocutaneostomy. The smallest (200 ml) and largest (3,500 ml) blood loss occurred in patients who underwent Bricker ileal conduit formation. Ten conversions to open surgery (5 in the group of patients who had a urinary reservoir and 5 in ileoconduit) were noted. Nine patients developed postoperative complications, with seven exhibiting Clavien–Dindo grade IIIa–IIIb complications. The median follow-up was 19.7 months. Disease progression occurred in two (9%) patients. One patient died 1.5 years after surgery due to underlying disease progression.

CONCLUSIONS: Robot-assisted cystectomy is currently limited to specialized centers. The exchange of experience between them and its analysis are crucial to assess the immediate and long-term results of this technique and determine the category of patients who will benefit most from its application.

Keywords: bladder cancer; radical cystectomy; urine derivation; Studer; Bricker; ureterocutaneostomy robot-assisted surgery.

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Анализ опыта робот-ассистированных цистэктомий с различными видами деривации мочи

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АННОТАЦИЯ

Актуальность. Радикальная цистэктомия — основной метод лечения пациентов с мышечно-инвазивным раком мочевого пузыря. В последние годы все большее распространение получают робот-ассистированные операции, что требует анализа результатов применения данной методики.

Цель — анализ собственного опыта выполнения робот-ассистированной радикальной цистэктомии с различными видами деривации мочи и сопоставление его с результатами, полученными другими центрами.

Материалы и методы. Проведен ретроспективный анализ результатов лечения 23 пациентов, которым в период с 2021 по 2024 г. выполнена робот-ассистированная цистэктомия с различными видами деривации мочи по поводу рака мочевого пузыря.

Результаты. Пациенты, которым формировали мочевой резервуар по Studer, были несколько моложе, имели лучший функциональный статус и больший индекс массы тела. Среди них также было больше пациентов со стадией cT1 группы очень высокого риска. В группе пациентов, которым выполняли уретерокутанеостомию, чаще встречалась стадия cT3-4. Длительность операции в среднем составляла 418,2 мин. Наибольшая длительность (533,5 мин) отмечена при формировании мочевого резервуара, наименьшая (294,3 мин) — при уретерокутанеостомии. Наименьшая (200 мл) и набольшая (3500 мл) кровопотеря имела место у пациентов, которым выполнено формирование илеокондуита по Брикеру (Bricker). Конверсий к открытой операции было 10 (5 — в группе пациентов, которым формировали мочевой резервуар, и 5 — илеокондуит). У 9 пациентов развились послеоперационные осложнений, по Clavien – Dindo IIIa–IIIb степеней — у 7. Медиана наблюдения составила 19,7 мес. Прогрессирование заболевания случилось у 2 (9 %) пациентов. Один пациент умер через 1,5 года после операции в связи с прогрессированием основного заболевания.

Выводы. Робот-ассистированная цистэктомия в настоящее время ограничена специализированными центрами. Обмен опыта между ними и его анализ необходимы для оценки ближайших и отдаленных результатов данной методики, а также определения категории пациентов, которые в наибольшей степени выиграют от ее применения.

Ключевые слова: рак мочевого пузыря; радикальная цистэктомия; деривация мочи; операция Штудера; операция Брикера; уретерокутанеостомия; робот-ассистированные операции.

Как цитировать

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BACKGROUND

Bladder cancer (BC) ranks tenth among the most common malignant neoplasms in adults. In 2020, 573,278 new cases were diagnosed worldwide [1]. In the Russian Federation, the prevalence of BC is 80.3 cases per 100 thousand populations, and the mortality rate in the first year after its detection is 12.3% [2].

Radical cystectomy remains the standard treatment method for patients with muscle-invasive BC, non-muscle-invasive BC of extremely high-risk, and cases unresponsive to chemo- and immunotherapy [3, 4]. In recent years, robot-assisted radical cystectomy (RARC) has become increasingly popular among oncourologists [5]. With the advent of any new technology, several practical questions inevitably arise. Is this technology feasible for solving a specific clinical task? Is it effective and safe? Is it advantageous over existing methods? In what cases will the use of new technology bring the best results? [6].

Meta-analyses of clinical studies have shown that RARC is not inferior to open surgery in terms of oncological results; however, it has lower morbidity rates. This surgery is characterized by lower intraoperative blood loss, low frequency of blood transfusions, and shorter hospital periods. However, robotic technology does not reduce the overall number of complications, the surgical time is longer, and the equipment is expensive, which makes them inaccessible [7–9]. Thus, centers are encouraged to share their experience in performing these surgeries. Analyses will help identify patients who can benefit the most from the use of this technique, evaluate the technical aspects of performing various stages of the surgery, identify risk factors for complications, and develop recommendations for their prevention.

This study aimed to analyze our experience of RARC using various types of urine derivation and compare it with the results obtained in other centers.

MATERIALS AND METHODS

The immediate oncological and functional treatment outcomes in 23 patients (22 men and 1 woman) who underwent RARC using one of the urine derivation methods for BC in the period from 2021 to 2024 were analyzed, respectively.

In addition to general clinical methods, preoperative examinations included magnetic resonance imaging of the pelvic organs, computed tomography of the chest, abdominal and pelvic organs, and urethrocystoscopy with bladder biopsy. Indications for cystectomy were histologically confirmed muscle invasion of the tumor, extremely high-risk non-muscle-invasive BC, and cases with failed organ-preserving treatment (transurethral resection of the bladder with intravesical chemo- or immunotherapy). All patients underwent cystectomy using the standard technique using the Da Vinci Si robotic system from 2021 to 2023 (Intuitive Surgical, USA) and Da Vinci Xi from 2024 (Intuitive Surgical).

Surgical technique

The patient is placed in the Trendelenburg position with the head end lowered by 30°. The abdominal cavity is punctured with a Veress needle. Carboxyperitoneum is created (10–12 mm Hg), and six ports are then installed (Fig. 1). The robotic system is docked. The peritoneum is opened above the ureters, which are then isolated along the length from the intersection with the iliac vessels to the bladder, where two metal clips are applied to them, whereas the ureters are transected between them. The peritoneum is arcuately dissected in the rectovesical recess. This incision is connected with the incisions for access to the ureters. The posterior wall of the bladder is mobilized. The vas deferentia are isolated and transected. The seminal vesicles are then isolated. The prostate gland is separated from the rectum, the peritoneum is opened parallel to the umbilical ligaments, and the latter are transected. The anterior and lateral surfaces of the urinary bladder are mobilized. The pelvic fascia is dissected on the sides of the prostate gland. The puboprostatic ligaments are transected. The dorsal venous complex is sutured and transected, and the prostate gland is dissected from the urethra. Thereafter, the posterior wall of the urethra is sutured with a thread with two needles to form an anastomosis with the urinary reservoir. The urinary bladder with the prostate gland and seminal vesicles, excised as a single block, is placed in a sealed container (removed at the end of the surgery with all the specimens). The fatty tissue with lymph nodes is excised along the iliac vessels to

Fig. 1. Robotic and assistants ports placement
Рис. 1. Установка роботических и ассистентских портов

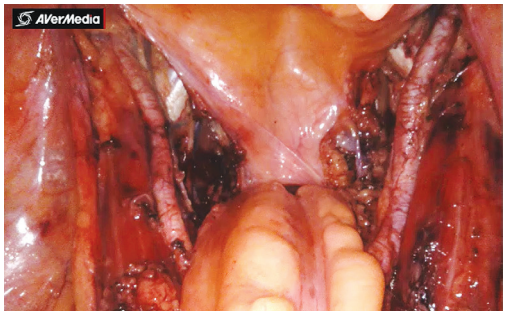

Fig. 2. View of the surgical field after performing extended pelvic lymphadenectomy
Рис. 2. Вид операционного поля после выполнения расширенной тазовой лимфаденэктомии

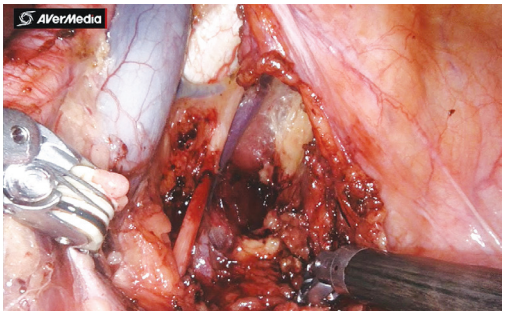

Fig. 3. Left fossa obturatoria area after lymphadenectomy
Рис. 3. Область запирательной ямки слева после лимфаденэктомии

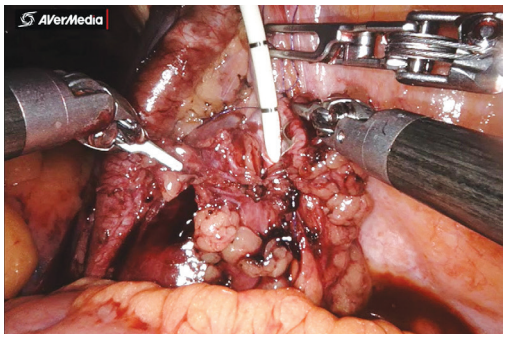

Fig. 4. Formation of ureteroureteroanastomosis according to Wallace technique. Ureteral stent placement
Рис. 4. Формирование уретероуретероансатомоза по Wallace. Установка мочеточникового стента

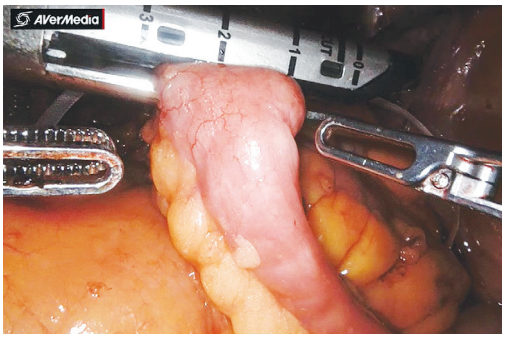

Fig. 5. The ileum transection using a linear suturing device (intestinal graft collection stage)
Рис. 5. Пересечение подвздошной кишки с помощью линейного сшивающего аппарата (этап забора кишечного трансплантата)

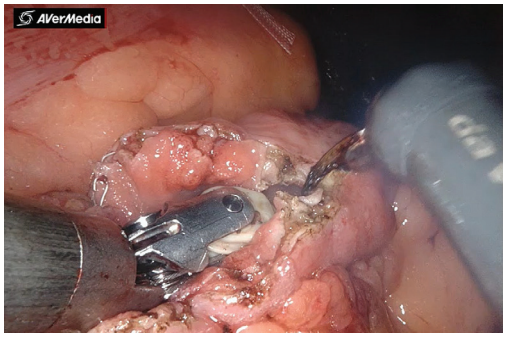

Fig. 6. Ileum detubularization along the mesenteric margin (neobladder formation stage)
Рис. 6. Детубуляризация подвздошной кишки по противобрыжеечному краю (этап формирования необладдера)

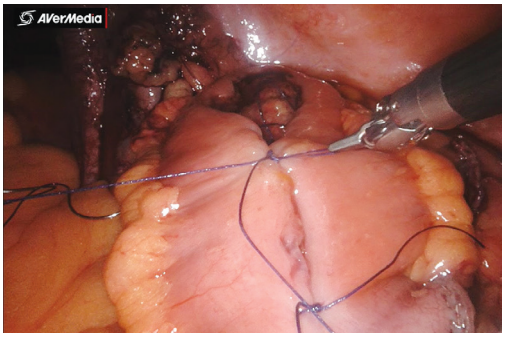

Fig. 7. The anterior neobladder wall formation (using a single-row serous-muscular continuous Vicryl suture 3-0)
Рис. 7. Формирование передней стенки необладдера (однорядный серозно-мышечный непрерывный викриловый шов 3-0)

their bifurcation (Fig. 2) and along the obturator nerve (Fig. 3) on both sides. These anatomical structures are skeletonized. An opening is created in the mesentery of the sigmoid colon, through which the left ureter is moved to the right iliac region. The distal part of the ureters with clips is dissected and placed in a sealed container. The ureters are sutured using the Wallace technique. An additional 5-mm trocar is installed along the edge of the rectus abdominis, 2 cm above the Lanz line. External ureteral stents 8 Ch/Fr are inserted into the abdominal cavity through it. Stenting of both ureters is performed (Fig. 4). The Da Vinci robotic system is undocked. The patient's body tilt angle is changed (Trendelenburg position 5°). The optics is replaced by 30°. Then, the Da Vinci robotic system is redocked.

The further course of the surgery differs depending on the choice of the urine derivation method. When forming a urinary reservoir using the Studer technique, a 55-cm-long segment of the ileum (20 + 20 + 15) is isolated 25 cm from the ileocecal junction. The intestine is transected using a linear suturing device (Fig. 5). The patency of the small intestine is restored by hardware (Endo GIA™ 45 and 60 mm) application of antiperistaltic laterolateral anastomosis. The distal 40 cm of the section of the future

reservoir are detubularized along the antimesenteric edge (Fig. 6), located U-shaped, and sutured with a continuous single-row suture. The resulting posterior wall of the urinary reservoir is folded transversely in a ratio of 2/3 to 1/3. The longitudinal part of the anterior wall is formed using a continuous suture (Fig. 7). One-third of the reservoir anterior wall is left unsutured to preserve a "process window" through which manipulations are performed inside the urinary reservoir. The ureters are implanted in its non-detubularized proximal part and fixed to its wall using a continuous suture. At the lowest point of the caudal part of the urinary reservoir, a 3-mm long incision is made through which ureteral stents are brought out. A 20 Ch/Fr urethral silicone catheter is passed into the urinary reservoir. The "process window" in the anterior wall of the urinary reservoir is closed using a continuous suture. The urinary reservoir is lowered into the small pelvis, where its anastomosis with the urethra is formed. To assess the reservoir tightness, 50 mL of 0.9% sodium chloride solution is poured into it.

During ureterocutaneostomy (UCS), external ureteral stents are inserted into the abdominal cavity through the assistant port, which are passed along the ureters to the renal pelvis. In both iliac regions, channels are formed, which pass through the subcutaneous fatty tissue, anterior abdominal wall, and peritoneum, through which the stented ureters are brought out, where they are fixed without tension to the skin with four interrupted sutures so that their distal end protrudes above the skin surface by at least 2 cm.

When forming an ileal conduit using the Bricker technique, a 25–30 cm long segment of the ileum is mobilized at a distance of 25 cm from the ileocecal junction. The intestine is transected using a linear suturing device. The patency of the small intestine is restored by applying a hardware for antiperistaltic laterolateral anastomosis.

Final stages of the surgery

A silicone drain is installed in the small pelvis through the assistant port. The robotic system is undocked. All tissues to be excised, previously placed in a sealed container, are removed from the abdominal cavity through a minilaparotomy (5 cm) midline approach. The wounds are sutured by layer.

Urine diversion by UCS was performed in 7 patients, an ileal conduit was formed using the Bricker method in 6, and orthotopic ileocystoplasty according to Studer was performed in 10. The choice of the urine derivation method was determined during the preoperative discussion of the clinical situation considering the extent of the tumor extension and the patient's functional status and consent.

Clinical and perioperative parameters and intra- and postoperative complications were analyzed. Given the small number of events analyzed in each group, descriptive statistical methods were used, and the mean and mean-square deviation σ (with a normal distribution of the studied parameter) and the median and spread of values (with a distribution different from normal) were calculated.

RESULTS

The clinical characteristics of patients with BC who underwent RARC are presented in Table 1. Most patients underwent neobladder formation using the Studer technique. In this group, patients were younger and had a better functional status, assessed by the Eastern Cooperative Oncology Group scale. Moreover, patients often had a higher body mass index, disease stages cT1–2, and very high-risk non-muscle-invasive BC.

Patients who underwent Bricker ileal conduit diversion or UCS more often had stage cT3–4 disease. The intraoperative parameters of patients with different types of urinary derivation after cystectomy are presented in Table 2. Expectedly, the neobladder formation group had the longest surgical duration and the largest number of excised lymph nodes. The Bricker ileal conduit group had the greatest blood loss and a higher rate of positive surgical margins (R1).

The results of the analysis of the early postoperative course is presented in Table 3. In the early postoperative period, complications developed in 9 (39%) patients within 1–16 days after surgery. In most cases, this was obstructive pyelonephritis, which required percutaneous puncture nephrostomy. This complication was classified as stage IIIa according to the Clavien–Dindo classification. Nephrostomies were closed after the resolution of pyelonephritis and restoration of urine passage. In one patient who underwent cystoprostatectomy with extended pelvic lymphadenectomy, laparotomy was performed on postoperative day 2 due to a decrease in the hemoglobin level. During the revision, diffuse tissue hemorrhage was detected, which was stopped using hemostatic sponges.

Histological examination confirmed the presence of urothelial carcinoma in all patients, namely, high-grade carcinoma in 13 and low-grade carcinoma in 1; however, the degree of tumor malignancy could not be assessed in eight patients because of therapeutic pathomorphosis. According to the results of histological examination of the excised tissue, stage pT1 of BC was detected in 9 (39.1%) patients, pT2a in 3 (13.0%), pT2b in 1 (4.3%), pT3a in 4 (17.4%), pT3b in 2 (8.7%), and pT4a in 3 (13.0%). Stage pT0 was registered in 1 (4.3%) patient. Concurrent carcinoma in situ was determined in 13 patients. Metastases to regional lymph nodes were revealed in 4 (17.4%) patients, namely, pN1 in 2 (8.7%) and pN2 and pN3 in 1 case each (4.3%).

Table 1. Clinical characteristics of bladder cancer patients who underwent robot-assisted radical cystectomy (*n* = 23)

Таблица 1. Клиническая характеристика пациентов с раком мочевого пузыря, перенесших робот-ассистированную радикальную цистэктомию (*n* = 23)

Parameter	All patients (*n* = 23)	Urine derivation method		
		by Studer (*n* = 10)	by Bricker (*n* = 6)	UCS/УКС (*n* = 7)
Mean age, years	63.4 ± 7.7	60.2 ± 7.8	66.6 ± 9.4	65.2 ± 4.5
Charlson comorbidity index, scores, median (minimum–maximum)	5 (3–13)	5 (3–8)	5 (5–6)	6 (4–13)
ECOG-0, *n*	14	7	3	4
ECOG-1, *n*	9	3	3	3
ASA-2, *n*	7	4	2	1
ASA-3, *n*	6	6	4	6
Mean body mass index, kg/m^2	26.7 ± 6.8	28.8 ± 7.6	26.8 ± 3.7	24.3 ± 4.1
Bladder cancer stage cT1, extremely high-risk group, *n*	10	6	1	3
cT2, *n*	4	3	1	–
cT3, *n*	6	1	2	3
cT4a, *n*	3	–	2	1
Previous treatment for bladder cancer (transurethral resection and intravesical chemotherapy), *n*	11	4	2	5

Note. No differences were noted in absolute values depending on the method of urine derivation ($p > 0.05$). UCS, ureterocutaneostomy; ASA, American Society of Anesthesiologists; ECOG, Eastern Cooperative Oncology Group.

Примечание. Различия значений абсолютных показателей в зависимости от способа деривации мочи отсутствуют ($p > 0,05$). УКС — уретерокутанеостомия; ASA — шкала оценки операционно-анестезиологического риска (American Society of Anesthesiologists physical status classification system); ECOG — шкала оценки функционального статуса пациента (Eastern Cooperative Oncology Group Performance Status Scale).

Table 2. Intraoperative parameters of bladder cancer patients with different methods of urine diversion after robot-assisted radical cystectomy (*n* = 23)

Таблица 2. Интраоперационные показатели пациентов с раком мочевого пузыря с разными методами деривации мочи после робот-ассистированной радикальной цистэктомии (*n* = 23)

Parameter	All patients (*n* = 23)	Urine derivation method		
		by Studer (*n* = 10)	by Bricker (*n* = 6)	UCS/УКС (*n* = 7)
Surgery time, min, median (minimum–maximum)	418.2 (225–675)	533.5* (325–675)	403.3 (260–630)	294.3 (225–380)
Blood loss, mL, median (minimum–maximum)	508.3 (100–1300)	361.1 (150–700)	1062.5* (200–3500)	308.3 (100–700)
Lymphadenectomy, *n*	17	6	5	6
Excised lymph nodes, *n*, median (minimum–maximum)	9 (1–29)	15 (12–26)	10 (1–29)	12 (3–19)
R1, *n*	4	0	3	1
Number of conversions to open surgeries, *n*	10	5	5	0

Note. UCS, ureterocutaneostomy; R1, positive surgical margin. *Difference with the values of indices in other methods of urine derivation is reliable ($p < 0.05$).

Примечание. УКС — уретерокутанеостомия; R1 — положительный хирургический край. *Различие со значениями показателей при других методах деривации мочи достоверно ($p < 0,05$).

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Table 3. Characteristics of the postoperative period of bladder cancer patients with different methods of urine derivation after robot-assisted radical cystectomy (*n* = 23)

Таблица 3. Характеристика послеоперационного периода у пациентов с раком мочевого пузыря с разными методами деривации мочи после робот-ассистированной радикальной цистэктомии (*n* = 23)

Parameter	All patients (*n* = 23)	Urine derivation method		
		by Studer (*n* = 10)	by Bricker (*n* = 6)	UCS/УКС (*n* = 7)
Number of bed-days in the intensive care unit after surgery, days, median (minimum–maximum)	2 (1–5)	2 (1–5)	2 (1–4)	1 (1–2)
Complications according to Clavien–Dindo				
Stage II, *n*	3	2	1	0
Stage IIIa, *n*	5	2	3	0
Stage IIIb, *n*	1	0	0	1
Average number of bed-days in the hospital after surgery, days	22.9 ± 6.1	20.6 ± 7.1	17.0 ± 4.2	17.1 ± 5.0

Note. UCS, ureterocutaneostomy. No differences were found in the values of absolute indices depending on the method of urine derivation ($p > 0.05$).

Примечание. УКС — уретерокутанеостомия. Различия значений абсолютных показателей в зависимости от способа деривации мочи отсутствуют ($p > 0,05$).

In 9 (41%) patients, urothelial carcinoma was not the only oncological disease. Synchronous prostate disease was detected in 7 (31.8%) patients, and metachronous disease was revealed in 1 (4.5%). Metachronous renal pelvis disease and metachronous hepatocellular carcinoma were detected in one patient each (4.5%).

The quality of life of patients was also assessed using the Short-Form 36 (SF-36) questionnaire. The physical health indicators of patients with an orthotopic bladder (Studer surgery) were significantly higher ($p < 0.05$) than those of patients with an ileal conduit (Bricker surgery) and UCS, with 64.8 ± 8.1, 39.0 ± 4.9, and 34.8 ± 5.7 points, respectively. A similar trend was noted for mental health indicators (75.8 ± 7.3, 34.0 ± 6.1, and 38.4 ± 5.0 points, respectively) and quality of life (70.3 ± 9.1, 36.5 ± 5.4, and 36.6 ± 3.1 points, respectively). The differences in the values of the above parameters in patients with neobladder (Studer surgery) compared with patients with other methods of urinary derivation were significant ($p < 0.05$).

To date, the median follow-up of patients is 19.7 months. Disease progression was noted in 2 (9%) patients. In one patient, ureterectomy (implantation metastasis) was performed, and in a patient with stage pT4a pN2 cM0, bone metastases were found 4 months after the surgery, due to which the patient underwent chemotherapy. Deaths occurred 1.5 years after surgery.

DISCUSSION

Despite the widespread use of robotic surgery in the last decade, remains a rarely performed surgery because only a small number of centers have RARC capability. This surgical intervention is technically complex and lengthy and requires expensive equipment. In this study, the results of the first 23 surgeries (learning curve) were presented. Most patients underwent cystectomy, followed by a urinary reservoir created using the Studer technique, whereas half of them received it with a completely intracorporeal version. When comparing our results with data from Russian centers, a slightly longer operative time and average blood loss were noted; however, a lower number of complications and disease progression were observed (Table 4), which may be due to the different clinical characteristics of the patients.

In this study, the greatest blood loss was registered in the Bricker ileal conduit patients. In this group, more patients had stages T3–4 and positive surgical margins (R1), which indicates a greater prevalence of the tumor process and technical difficulties in performing cystectomy. The most common complication in patients after neobladder formation according to Studer and an ileal conduit according to Bricker was obstructive pyelonephritis, which may indicate the need for an optimal technique for creating an anastomosis between the ureters and the urinary reservoir (conduit).

In this study, we attempted to analyze the perioperative results of robot-assisted surgeries without comparing them with open ones because this study mainly aimed to assess the technical feasibility and safety of this technique and determine patients for whom its use is most appropriate. In general, our results are comparable with the results of other centers at the stage of mastering this technique (Table 4).

Table 4. Results of robot-assisted radical cystectomies
Таблица 4. Результаты робот-ассистированной радикальной цистэктомии

Authors, year	Urine derivation method			Average surgery time, min	Average blood loss, mL	Complications				Progression, *n*
	by Bricker, *n*	by Studer, *n*	UCS/ УКС, *n*			in the first 30 days, *n*	Clavien–Dindo III–V, *n*	in the first 90 days, *n*	Mortality, *n*	
D.A. Lakhno et al., 2018 [10]	13*	5	2	н/у	н/у	7 (35%)	5 (25%)	5 (25%)	–	4 (20%)
B.G. Guliev and R.R. Bolotkov, 2020 [11]	–	16**	–	380	н/у (80–200)	7 (43.7%)	3 (18.7%)	6 (37.5%)	1 (6%)	н/у
V.N. Pavlov et al., 2022 [12]	67	3	–	220	280	9	5	4	3 (4.2%)	н/у

Note. UCS, ureterocutaneostomy; н/у, not specified; *intracorporeal; **all intracorporeal.
Примечание. УКС — уретерокутанеостомия. н/у — не указано; *интракорпоральные; **все интракорпоральные.

CONCLUSIONS

BC remains an urgent problem of modern healthcare, requiring huge treatment costs for each patient. Reducing the hospital stay in the postoperative period can reduce treatment costs. The use of robotic technology can reduce morbidities associated with cystectomy and shorten the rehabilitation period. RARC is a technically feasible and safe technique that can be employed when performing any type of urinary derivation.

ADDITIONAL INFORMATION

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: D.M. Monakov — data collection, analysis of the data obtained, writing the text of the manuscript; L.T. Savin — data collection, patient management; A.G. Kochetov — concept and design of the study, analysis of the data obtained, editing the text of the manuscript; N.A. Karelskaya — performing diagnostic tests, data collection; T.A. Dmitrieva — data collection, patient management; V.A. Oganyan — data collection, patient management, writing the text of the manuscript; R.N. Magomedov — anesthetic support for surgeries, data collection; A.A. Gritskevich — concept and design of the study, performing surgical interventions, editing the text of the manuscript, general supervision of the study.

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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: Д.М. Монаков — сбор и анализ полученных данных, написание текста рукописи; Л.Т. Савин — сбор данных, ведение пациентов; А.Г. Кочетов — концепция и дизайн исследования, анализ полученных данных, редактирование текста рукописи; Н.А. Карельская — выполнение диагностических исследований, сбор данных; Т.А. Дмитриева — сбор данных, ведение пациентов; В.А. Оганян — сбор данных, ведение пациентов, написание текста рукописи; Р.Н. Магомедов — анестезиологическое обеспечение операций, сбор данных; А.А. Грицкевич — концепция и дизайн исследования, выполнение хирургических вмешательств, редактирование текста рукописи, общее руководство исследованием.

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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