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Outcomes of the prevention and treatment of bladder neck contracture, with complication severity assessed using the Clavien-Dindo classification

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Abstract. Bladder neck contracture is one of the most common complications following surgical treatment of benign prostatic hyperplasia. It impairs lower urinary tract urodynamics and carries a high risk of repeat surgery. This study aimed to improve the outcomes of the prevention and treatment of bladder neck contracture, with the severity of postoperative complications assessed using an adapted Clavien-Dindo classification. The study included 106 patients with bladder neck contracture who underwent surgery between 2020 and 2025. The main group comprised 56 patients who received local postoperative administration of Longidaza® according to the protocol developed by the authors, while the control group included 50 patients who received the drug intramuscularly. The effectiveness of prevention and treatment was evaluated using urodynamic and instrumental examinations and by assessing the severity of postoperative complications according to the Clavien-Dindo classification adapted for the surgical treatment of bladder neck contracture. Treatment was effective in 92.9% of patients in the main group and 66.0% of those in the control group, while recurrence rates were 7.1% and 34.0%, respectively. During the first postoperative month, bladder function improved relative to preoperative values in both groups, with statistically significant differences also observed between the groups ($p < 0.05$). At one year, the maximum urinary flow rate (Qmax) reached 22.45 ± 2.78 mL/s in the main group, compared with 15.62 ± 1.54 mL/s in the control group. Residual urine volume decreased to 20.02 ± 8.48 mL and 70.34 ± 11.25 mL, respectively. Postoperative complications corresponded to Grades I-III of the adapted Clavien-Dindo classification; no Grade IV or V complications were recorded. In 44.3% of cases, postoperative complications were classified as minor and were managed conservatively; 36.2% of these cases occurred in the main group and 63.8% in the control group. Disease recurrence was confirmed in 19.8% of cases and required repeat surgery; 19.0% of recurrent cases occurred in the main group and 81.0% in the control group. When recurrent bladder neck contracture was diagnosed, repeat surgery was performed between six months and one year after the initial procedure. Treatment consisted of transurethral resection followed by local and intramuscular administration of the antifibrotic agent according to the protocol developed by the authors. No further recurrence was recorded during the subsequent 6-12 months

Keywords: bladder outlet obstruction; lower urinary tract; antifibrotic agent; disease recurrence; urodynamics

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Introduction

Despite advances in contemporary clinical urology, the prevention and treatment of bladder neck contracture (BNC) following surgical treatment of benign prostatic hyperplasia (BPH) remain clinically significant. This is attributable to the high risk of disease recurrence and the absence of generally accepted criteria for selecting the optimal treatment strategy. BNC is one of the most common complications following surgical treatment of patients with BPH. According to Sh.A. Abbosov *et al.* [1], the incidence of BNC after transurethral procedures may reach 10% following primary surgery and increase to 15% after repeat procedures.

According to the guidelines of the European Association of Urology [2], the incidence of BNC is approximately 2.4%-9.7% after transurethral resection of the prostate (TURP), up to 5.4% after holmium laser enucleation of the prostate, up to 3.6% after photoselective vaporisation of the prostate, and up to 6% after open adenomectomy. Numerous endoscopic and reconstructive surgical techniques have been proposed for the treatment of BNC [3]. According to L. Zhang *et al.* [4], the effectiveness of surgical treatment for BNC ranges from 72% to 100%. M.I. Katibov *et al.* [5] reported that the use of electrical or laser energy during transurethral procedures may result in dense scar formation at the bladder neck because of excessive resection or pronounced thermal injury. During adenomectomy, scar tissue may develop as a consequence of excessive surgical trauma or improper closure of the prostatic adenoma bed.

Complications of varying severity may occur after any surgical procedure. The Clavien-Dindo classification is widely used in surgical practice to assess the severity of postoperative complications. According to SH. Giyasov *et al.* [6], there is still no consensus in clinical urology regarding the definition and assessment of postoperative complications using a standardised system. Therefore, to provide an objective assessment of surgical quality, the Clavien-Dindo classification should be adapted to the underlying disease, the specific treatment method, and the course of the postoperative period. Accurate classification of complications using an adapted system enables not only an objective evaluation of treatment outcomes but also the planning of subsequent therapy, preventive measures, and patient rehabilitation.

The challenges associated with the surgical treatment of patients with BNC and the assessment of postoperative complication risk remain relevant, as do the treatment and prevention of recurrent scar formation in the bladder neck. One important area of research is the identification of pharmacological agents capable of reducing the incidence of complications following surgical treatment of BPH. According to S.V. Kotov *et al.* [7], the use of Longidaza® as part of combination therapy after transurethral resection of the prostate significantly reduces the incidence of recurrent leukocyturia and bacteriuria. This is associated with a tendency towards fewer infectious complications and a reduced need for additional antibacterial therapy. Clinical observations reported by A.E. Almerekov *et al.* [8] indicate that the enzymatic antifibrotic agent bovhyaluronidase azoximer (Longidaza®) prevents the formation of dense scar tissue in the bladder neck and improves lower urinary tract function, as evidenced by an increased urinary flow rate and a reduced residual urine volume.

The search for new treatment strategies and the optimisation of existing approaches for patients with BNC are ongoing. Further investigation of risk factors for postoperative complications remains necessary, while diagnostic criteria and more effective therapeutic and preventive measures continue to be developed. The need to improve treatment outcomes and preventive strategies and to provide an objective assessment of the severity of postoperative complications associated with BNC underlines the importance of further research in this field. This study aimed to evaluate the effectiveness of the prevention and treatment of bladder neck contracture, with the severity of postoperative complications assessed using the Clavien-Dindo classification.

Materials and Methods

A prospective, controlled, randomised study was conducted involving 602 patients with benign prostatic hyperplasia (BPH). All patients underwent surgical treatment at the Republican Scientific Centre of Urology of the National Hospital under the Ministry of Health of the Kyrgyz Republic between 2020 and 2025. Of the total cohort, 106 patients (17.6%) who developed BNC during the postoperative period were selected for further analysis. The inclusion criteria were male sex; a clinical diagnosis of BNC following open or laparoscopic adenomectomy, transurethral resection of the prostate (TURP), or holmium laser enucleation of the prostate (HoLEP); recurrent BNC; a postoperative follow-up period ranging from three months to two years; and voluntary consent to participate in the study. The exclusion criteria were malignant neoplasms of the prostate, neurogenic voiding dysfunction, and general medical contraindications to surgery.

The study was conducted in accordance with the international ethical principles for biomedical research set out by the World Medical Association [9]. Written informed consent was obtained from all participants. The patients were aged 65-83 years, with a mean age of 73.2 ± 2.43 years. In accordance with the study aim, the 106 patients were allocated to two comparison groups. The first, or main, group comprised 56 patients (52.8%) who underwent surgical treatment for BNC and received the enzymatic antifibrotic agent Longidaza® according to the protocol developed by the authors, together with standard postoperative therapy. The second, or control, group comprised 50 patients

(47.2%) who underwent surgical treatment for BNC and received intramuscular Longidaza® in combination with standard therapy. All patients with BNC underwent surgical treatment by transurethral resection (TUR) or transurethral laser incision of scar tissue under spinal anaesthesia (Fig. 1).

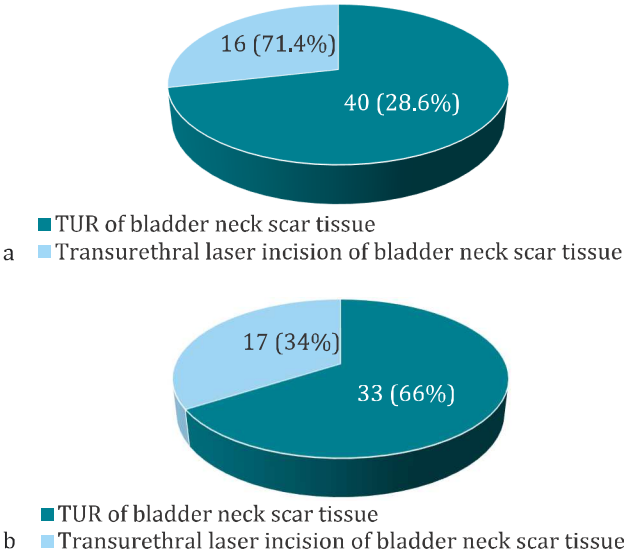


Figure 1. Distribution of surgical treatment methods for BNC in the comparison groups
Note: a – patients in the main group; b – patients in the control group
Source: created by the authors

The BNC treatment method developed for patients in the main group comprised TUR or transurethral laser incision of bladder neck scar tissue combined with intraoperative administration of Longidaza® into the submucosal layer of the bladder neck at the 3, 6, 9, and 12 o'clock positions. A dose of 3,000 IU (20 mg) was dissolved in 2.0 mL of 0.9% sodium chloride solution, and 5 mg (0.5 mL) was injected at each site. On the third day after removal of the urethral catheter, the drug was administered in the same manner to the same sites under visual guidance using a urethrocystoscope. Longidaza® was then administered intramuscularly every three days for one month. Standard postoperative treatment included analgesics prescribed according to pain intensity assessed using the visual analogue scale (VAS), antibacterial agents selected with regard to the urinary microflora, urinary antiseptics, haemostatic agents, and antipyretics, as clinically indicated.

Postoperative diagnostic screening was based on the detection of symptoms of bladder outlet obstruction (BOO) by urodynamic and instrumental examinations. The duration of surgery, volume of intraoperative blood loss, time to urethral catheter removal, and time to patient mobilisation were also assessed. Treatment effectiveness was evaluated by analysing the severity of postoperative voiding symptoms, urinary flow rate measured by uroflowmetry, and residual urine volume determined by ultrasonography. The following values were regarded as normal urodynamic parameters: Qmax greater than 15 mL/s, Tflow no longer than 20 seconds at a voided volume of 150250 mL, and a residual urine volume of no more than 50 mL on ultrasonography. Urethrocystoscopy or urethrocystography was performed when signs of BOO were present (Fig. 2).



Figure 2. Urethrocystoscopic appearance of BNC
Source: authors' materials

The severity of postoperative complications was assessed using the Clavien-Dindo classification, adapted to reflect the specific features of the surgical treatment of patients with BNC.

Results

No statistically significant differences were found between the comparison groups in the duration of surgery (45.5 ± 15.4 minutes), volume of intraoperative blood loss (32.1 ± 11.2 mL), time to urethral catheter removal (2.6 ± 0.4 days), or time to patient mobilisation (2.1 ± 0.7 days; $p > 0.05$). The severity of postoperative complications was assessed using the adapted Clavien-Dindo classification (Table 1).

Table 1. Complications of surgical treatment for BNC according to the Clavien-Dindo classification

Complication grade	General description	Complications associated with BNC
I	Any deviation from the normal postoperative course not requiring pharmacological treatment, except symptomatic therapy	Transient macroscopic haematuria; moderate dysuria; pain; hyperthermia
II	Complications requiring pharmacological treatment, including antibacterial therapy, urinary antiseptics, blood transfusion, and other measures	Urinary tract infection; haematuria lasting more than 72 hours and requiring haemostatic therapy or blood transfusion; acute urinary retention; urinary incontinence; repeat urethral catheterisation

Table 1. Continued

Complication grade	General description	Complications associated with BNC
IIIa	Complications requiring surgical intervention without general anaesthesia	Bladder tamponade requiring clot evacuation under local anaesthesia; cystostomy; urethrocystoscopy
IIIb	Complications requiring surgical intervention under general anaesthesia	Bladder tamponade requiring endoscopic clot evacuation under spinal anaesthesia; recurrent BNC; urethral stricture; bladder perforation
IVa	Life-threatening complications involving dysfunction of a single organ	Urosepsis; acute renal failure; chronic renal failure; haemorrhagic shock
IVb	Multiple organ failure	Septic shock with multiple organ dysfunction
V	Death of the patient	Death of the patient

Source: compiled by the author

The postoperative complications recorded in the study population corresponded to Grades I-III of the Clavien-Dindo classification. Overall, 68 complications were identified in 64.2% of patients. Grade I complications were diagnosed in 22 patients (20.8%), Grade II complications in 25 patients (23.6%), Grade IIIa complications in 3 patients (2.8%), and Grade IIIb complications in 18 patients (17.0%). No Grade IV or V complications were observed (Fig. 3).

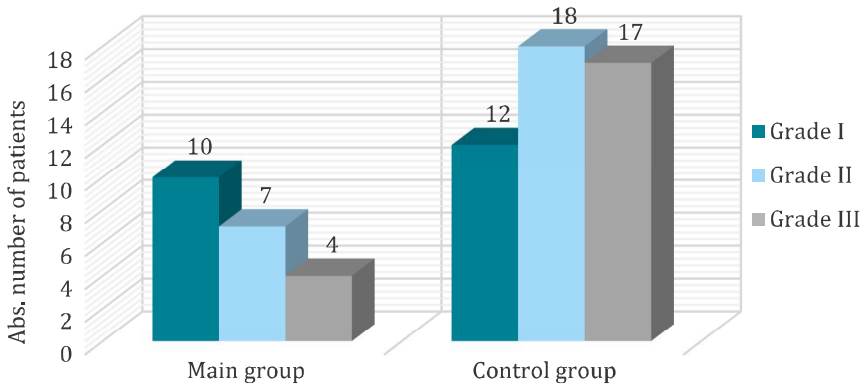


Figure 3. Distribution of postoperative complications in patients with BNC according to the Clavien-Dindo classification in the comparison groups

Source: compiled by authors

Grade I postoperative complications were observed in 10 patients (17.9%) in the main group and 12 patients (24.0%) in the control group. Of these, 8 patients (14.3%) in the main group and 10 patients (20.0%) in the control group experienced pain rated at 2-3 points on the visual analogue scale (VAS), accompanied by fever lasting up to 72 hours. These patients required analgesic and antipyretic treatment. Transient macroscopic haematuria occurred in 2 patients (3.6%) in the main group and 2 patients (4.0%) in the control group and did not require haemostatic therapy.

Grade II postoperative complications were diagnosed in 7 patients (12.5%) in the main group and 18 patients (36.0%) in the control group. Antibacterial agents and urinary antiseptics selected according to the urinary microbiota were required in 3 patients (5.4%) in the main group and 9 patients (18.0%) in the control group. Alpha-adrenergic blockers were administered because of obstructive voiding symptoms to 3 patients (5.4%) in the main group and 7 patients (14.0%) in the control group. Antimuscarinic agents were prescribed for urinary incontinence to 1 patient (1.8%) in the main group and 2 patients (4.0%) in the control group.

Grade III postoperative complications occurred in 4 patients (7.1%) in the main group and 17 patients (34.0%) in the control group. These complications were associated with recurrent cicatricial and sclerotic changes at the bladder neck incision site, requiring diagnostic urethrocystoscopy (Grade IIIa), followed by surgical treatment of recurrent BNC (Grade IIIb).

Overall, 47 complications (44.3%) were relatively minor and were managed conservatively. Of these, 17 cases (36.2%) occurred in the main group and 30 cases (63.8%) in the control group. Invasive intervention was required for 21 complications (19.8%), namely repeat surgery for recurrent BNC. Four of these cases (19.0%) occurred in the main group and 17 cases (81.0%) in the control group (Fig. 4).

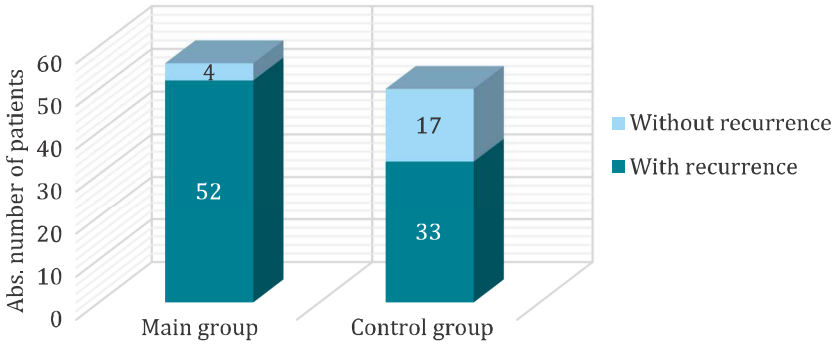


Figure 4. Assessment of the effectiveness of BNC treatment in the comparison groups
Source: compiled by authors

Treatment effectiveness in the main group was 92.9%, while the recurrence rate of BNC was 7.1%. In the control group, BNC treatment effectiveness was 66.0%, and disease recurrence occurred in 34.0% of cases. The effectiveness of the treatment method developed for BNC was assessed at one week, 2-4 weeks, 2-6 months, and 7-12 months after surgery (Table 2).

Table 2. Distribution of indicators of lower urinary tract function in the comparison groups

No.	Indicator/ comparison group	Postoperative follow-up period				
		Preoperative	1 week	2-4 weeks	2-6 months	7-12 months
		P ± m	P ± m	P ± m	P ± m	P ± m
1.	Maximum urinary flow rate, mL/s (Qmax)					
	Main group (n = 56)	9.56 ± 3.01	17.71 ± 2.34	19.56 ± 2.22	24.61 ± 3.44	22.45 ± 2.78
	Control group (n = 50)	9.37 ± 2.12	16.21 ± 1.28	18.43 ± 1.25	16.37 ± 1.45	15.62 ± 1.54
3.	Residual urine volume, mL					
	Main group (n = 56)	83.78 ± 13.61	32.51 ± 9.48	23.08 ± 10.44	18.85 ± 10.32	20.02 ± 8.48
	Control group (n = 50)	88.56 ± 15.21	45.22 ± 10.42	43.27 ± 9.49	65.56 ± 10.92	70.34 ± 11.25

Source: compiled by the author

During the early postoperative period, from one week to one month, bladder function improved relative to preoperative values according to uroflowmetry and ultrasonography in both groups. Statistically significant differences were also observed between the groups ($p < 0.05$). During the late postoperative period, from two months to one year, statistically significant differences were found between the groups for all clinical indicators. These differences suggested the development of BOO, which represented a prerequisite for recurrent BNC ($p < 0.05$). Recurrent BNC occurred in 21 patients (19.8%) and was classified as a Grade III complication. To treat BNC recurrence between six months and one year after the initial procedure, repeat surgery was performed in 4 patients (19.0%) in the main group and 17 patients (81.0%) in the control group. The incidence of complications depended on baseline risk factors, the surgical technique used, postoperative management, and the measures taken to prevent postoperative complications.

The prevention of recurrent BNC was crucial to achieving favourable outcomes in this study. This involved administering the enzymatic antifibrotic agent Longidaza® according to the protocol developed by the authors and continuing treatment throughout the postoperative wound-healing period. In patients with BNC who received combined surgical and conservative treatment, including Longidaza® injected into the submucosal layer of the bladder neck intraoperatively and on postoperative day 3, followed by intramuscular injections for one month, lower urinary tract function improved as early as the first postoperative week. Uroflowmetry and bladder ultrasonography showed a Qmax of 17.71 ± 2.34 mL/s and a residual urine volume of 32.51 ± 9.48 mL. This improvement was sustained over one year, when Qmax reached 22.45 ± 2.78 mL/s and residual urine volume decreased to 20.02 ± 8.48 mL.

Patients with BNC who received combined surgical and conservative treatment with intramuscular Longidaza® for one month after surgery also showed an initial increase in urinary flow rate and a reduction in residual urine volume compared with preoperative values. Qmax was 16.21 ± 1.28 mL/s at one week and 18.43 ± 1.25 mL/s at 2-4 weeks, while residual urine volume was 45.22 ± 10.42 mL and 43.27 ± 9.49 mL, respectively. However, after two months, lower urinary tract function deteriorated, and signs of BOO were identified. At that stage, Qmax was 16.37 ± 1.45 mL/s and residual urine volume was 65.56 ± 10.92 mL. These changes persisted for one year, when Qmax was 15.62 ± 1.54 mL/s and residual urine volume was 70.34 ± 11.25 mL. When recurrent BNC was confirmed, repeat surgery was

performed between six months and one year after the initial procedure. Treatment consisted of TUR followed by local and intramuscular administration of Longidaza® according to the protocol developed by the authors. No further recurrence was observed during the subsequent 6-12 months.

Discussion

Despite advances in operative urology, the treatment and prevention of BNC remain among the most complex and clinically relevant challenges. The absence of a standardised algorithm for the management, treatment, and rehabilitation of patients with BNC underlines the need to develop and introduce new approaches to this condition. The high recurrence rate following conventional endoscopic procedures has led to the development of combined treatment methods, including transurethral resection followed by the administration of antiproliferative and antifibrotic agents, such as mitomycin C, triamcinolone, and hyaluronidase. These agents are intended to suppress excessive scar formation and fibrosis at the surgical site, thereby reducing the risk of recurrent sclerosis and improving long-term treatment outcomes.

N.I. Sorokin *et al.* [10] reported that endoscopic cold-knife incision of the bladder neck combined with mitomycin C administration increased treatment effectiveness to 75%-90% after one or two injections and produced a sustained recurrence-free period in 75% of patients with BNC by inhibiting fibroblast proliferation. K.H. Pang *et al.* [11] reported that intravesical administration of a mitomycin C-containing hydrogel reduced the risk of recurrence of mild spongiofibrosis during one year of follow-up. According to L. Zhang *et al.* [4], following TUR of scar tissue, triamcinolone acetonide injections into the bladder neck every four weeks for one year under cystoscopic guidance can maintain a recurrence-free period. However, none of the available studies has assessed the effectiveness of additional corticosteroid administration into bladder neck scar tissue during endoscopic treatment [12]. M.H. Wu *et al.* [13] and Q. Wang *et al.* [14] suggested that transurethral incision of the bladder neck combined with local betamethasone injection may be a promising treatment option for BNC. Nevertheless, disease recurrence was observed in 35% of patients over a 36-month follow-up period. H. Shu *et al.* [15] reported that recurrent BNC may be treated by bladder neck augmentation using Y-V or T-flap plasty, with or without scar tissue resection. Anatomical patency rates over follow-up periods of 14-45 months ranged from 83% to 100%. M.A. Avallone *et al.* [16] described the successful use of robot-assisted subtrigonal augmentation with an inlay buccal mucosal graft, although this technique requires further investigation and discussion. As a preventive measure against BNC, the EAU clinical guidelines [12] describe the additional performance of transurethral incision of the prostate at the end of TURP. In this setting, the incidence of BNC was 6.0%. S.V. Popov *et al.* [17] reported that the effectiveness of procedures such as bougienage, balloon dilatation, endoscopic incision, and TUR of the bladder neck progressively decreases when they are repeated.

The treatment method developed for BNC comprised TUR or transurethral laser incision of scar tissue combined with intraoperative administration of Longidaza® into the submucosal layer of the bladder neck. A dose of 3,000 IU (20 mg) was injected at the 3, 6, 9, and 12 o'clock positions. On the third day after removal of the urethral catheter, the drug was administered in the same manner under urethrocystoscopic guidance. This was followed by intramuscular administration every three days for one month. The method proved effective in 92.9% of BNC cases, while disease recurrence was recorded in 7.1%.

The Clavien-Dindo classification is currently used to assess the severity of surgical complications. It helps standardise the evaluation of the safety of different treatment methods, determine the clinical significance of complications, and compare options for preventive and rehabilitation strategies [18-20]. Under this classification, any deviation from the normal course of the surgical procedure and/or postoperative period is regarded as a complication [21]. According to the adapted Clavien-Dindo classification, postoperative complications were identified in 68 patients with BNC (64.2%) and varied in nature. The most common were infectious and inflammatory disorders of the genitourinary system, diagnosed in 12 patients (17.6%; Grade II), and symptoms of BOO, observed in 10 patients (14.7%; Grades II-III). Forty-seven complications (44.3%) were classified as minor and managed conservatively. Of these, 17 cases (36.2%) occurred in the main group and 30 cases (63.8%) in the control group. Disease recurrence occurred in 21 cases (19.8%) and required repeat surgery; 4 of these patients (19.0%) belonged to the main group and 17 (81.0%) to the control group.

Conclusions

BNC remains one of the most common and difficult-to-treat complications following surgical treatment of BPH. The high recurrence rate, absence of a standardised algorithm for treatment and prevention, and limited effectiveness of existing therapeutic methods highlight the need to develop and introduce new approaches to the management of this condition. In recent years, particular attention has been given to antifibrotic agents intended to suppress excessive tissue scarring and prevent sclerosis at the surgical site. Experience in the surgical treatment of BNC enabled the development of a treatment protocol that proved effective, reduced the incidence of complications and disease recurrence, and shortened both postoperative hospital stay and rehabilitation. The proposed method for the treatment and prevention of BNC demonstrated

high clinical effectiveness in 92.9% of cases. Local intraoperative and early postoperative administration of Longidaza® significantly reduced the recurrence rate to 7.1%, compared with 34.0% in the control group, confirming its effectiveness in preventing recurrent scar formation.

During long-term follow-up, patients in the main group showed a significant improvement in urodynamic parameters. The maximum urinary flow rate increased from 9.56 ± 3.01 mL/s to 22.45 ± 2.78 mL/s, compared with an increase from 9.37 ± 2.12 mL/s to 15.62 ± 1.54 mL/s in the control group. At 12 months after treatment, residual urine volume had decreased from 83.78 ± 13.61 mL to 20.02 ± 8.48 mL in the main group, compared with a reduction from 88.56 ± 15.21 mL to 70.34 ± 11.25 mL in the control group. To treat recurrent BNC between six months and one year after the initial procedure, repeat surgery was performed in 4 patients (19.0%) in the main group and 17 patients (81.0%) in the control group. The adapted Clavien-Dindo classification enabled systematic monitoring of postoperative complications in patients with BNC, improved the objectivity of treatment-outcome assessment, and supported decisions regarding repeat intervention in cases of recurrence. The introduction of the Clavien-Dindo system into urological practice for patients with BNC has made it possible to objectively assess the severity of postoperative complications. Grade I complications were diagnosed in 22 patients (20.8%), Grade II complications in 25 patients (23.6%), Grade IIIa complications in 3 patients (2.8%), and Grade IIIb complications in 18 patients (17.0%). No Grade IV or V complications were observed. Conservative treatment was used in 47 cases (44.3%), including 17 cases (36.2%) in the main group and 30 cases (63.8%) in the control group. Repeat surgery for recurrent BNC was required in 21 patients (19.8%), including 4 patients (19.0%) in the main group and 17 patients (81.0%) in the control group.

The high incidence of BNC after surgical treatment of BPH may be attributed to the limited effectiveness of existing therapeutic and preventive methods and the insufficient evidence regarding their ability to prevent postoperative scarring at the site of endoscopic intervention. The absence of standardised anti-recurrence treatment regimens and the limited evidence concerning agents that affect scar formation at the incision site underline the relevance of the present study. The development of new, pathogenetically grounded methods for the prevention and treatment of BNC, aimed at reducing recurrence and improving quality of life, is therefore of considerable scientific and clinical interest. Addressing this problem may improve treatment effectiveness, reduce the need for repeat intervention, and enhance long-term functional outcomes.

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Conflict of Interest

None.

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Результаты профилактики и лечения рубцовой деформации шейки мочевого пузыря с оценкой тяжести осложнений по системе Clavien-Dindo

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Аннотация. Рубцовая деформация шейки мочевого пузыря является одним из наиболее частых осложнений после хирургического лечения доброкачественной гиперплазии предстательной железы и сопровождается нарушением уродинамики нижних мочевых путей с высоким риском повторных оперативных вмешательств. Целью исследования было улучшение результатов профилактики и лечения рубцовой деформацией шейки мочевого пузыря с оценкой тяжести послеоперационных осложнений по адаптированной системе Clavien-Dindo. В исследование включены 106 пациентов с рубцовой деформацией шейки мочевого пузыря, прооперированных в 2020-2025 гг. Основную группу составили 56 пациентов,