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CHOICE OF TREATMENT METHOD FOR SYMPTOMATIC BLADDER OUTLET OBSTRUCTION IN PATIENTS WITH BENIGN PROSTATIC HYPERPLASIA AFTER KIDNEY TRANSPLANTATION

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The paper presents a comparative assessment of different methods of treating symptomatic bladder outlet obstruction (BOO) in patients with benign prostatic hyperplasia (BPH) who underwent kidney transplantation (KT).

Keywords: bladder outlet obstruction, benign prostatic hyperplasia, kidney transplantation.

INTRODUCTION

Ninety-one years ago, on April 3, 1932, Soviet surgeon, Yury Voronoy, performed the first kidney transplantation (KT) in the world. Since then, there have been major breakthroughs in the field of KT in Russia and around the world [1–3]. KT is championed as the gold standard treatment for patients with end-stage kidney failure [3].

In 2018, over 95,000 KTs were performed worldwide [1]. In the Russian Federation, the number of kidney transplant surgeries increases every year [2].

In the early and late post-KT period, there is a high likelihood of various complications [4–8]. Urological complications in KT recipients, whose incidence is 3–14%, causes longer hospital stay, graft dysfunction and increased mortality [5–10]. One of the complications is bladder outlet obstruction (BOO) in the background of benign prostatic hyperplasia (BPH) [5, 6, 8, 11].

At the same time, the incidence of BPH-associated BOO in the postoperative period increases every year, as the age of recipients increases [4–8, 11, 12]. Urological problems in transplanted kidney recipients are associated with decreased graft survival and lead to higher morbidity and mortality [13–17].

The age of kidney transplant recipients increases every year and, on average, exceeds 55 years [14]. However, it should be taken into account that 50–70% of men over 50 years of age present with lower urinary tract symptoms (LUTS) associated with BPH; LUTS prevalence reaches 80% in men aged 80 [17].

In the pre-transplant period, against oliguria accompanying chronic kidney disease, symptoms of chronic urinary fade into the background and do not bother the patient. The patient may have no characteristic complaints. Whereas after successful KT, manifestations of BOO on the background of BPH increase and significantly worsen the quality of life (QoL) of patients.

In recent years, there have been significant advances in the treatment of urological complications, largely due to advances in therapy [6–16, 18–21]. A comparative analysis of the availability and efficacy of different methods of treatment of BOO against BPH in kidney transplant recipients is presented in this review.

METHODS OF TREATING SYMPTOMATIC BOO IN BPH PATIENTS WHO UNDERWENT KIDNEY TRANSPLANTATION

Treatment of BOO in KT recipients can be therapeutic, surgical, or combined [18, 19].

It is necessary that the above approaches be personalized after analyzing the comorbidities, age of the patient, size of the prostate gland, etc. [20–27]. After careful examination, the patient's management tactics are determined: dynamic monitoring, drug therapy or surgical treatment [20–26]. Surgical treatment is indicated if conservative approaches to BOO therapy fail [20–27].

Drug therapy for BOO in BPH patients who underwent kidney transplantation

Given the progressive nature of the disease, BPH medication therapy is carried out for a long time, in some patients – for theшк entire life. In BPH treatment in all patients, several kinds of medicines are used. However, the basic therapy consists of three groups of drugs: alpha-1 blockers (A1Bs, adrenergic alpha-1 receptor ant-

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agonists), 5-alpha-reductase inhibitors (5-ARIs), phosphodiesterase type 5 (PDE5) inhibitors [20–26, 28–31].

In the general population, drug treatment of BPH-associated LUTS in kidney transplant recipients initially includes alpha blockers and finasteride in most cases [31]. Medication therapy with A1Bs can be used as the first stage of treatment. Adrenergic alpha-1 receptor antagonists are first-line drugs and are used for moderate to severe lower urinary tract syndromes. The action of these drugs begins 48 hours after intake [28, 30].

Currently, five drugs of this group are used in clinical practice: alfuzosin, doxazosin, silodosin, tamsulosin, terazosin [28, 30, 32–34]. The differences between the listed drugs lie in their tolerability, which is due to their pharmacodynamics and pharmacokinetics. A1Bs are effective in correcting LUTS symptoms, but do not reduce prostate size or protect against the development of acute urinary retention in the long term. Tamsulosin is the most commonly used A1Bs in the world [28, 33].

Several randomized, placebo-controlled clinical trials (RPCCTs): three phase III RPCCTs and two phase IV RPCCTs have been performed to investigate the effectiveness of A1Bs in a subgroup of patients with severe BOO [28, 30, 32, 33].

Disease severity was assessed by two or more of the following criteria: International Prostate Symptom Score (IPSS), QoL score, maximum urinary output (Q_{max}) <5 mL/s or residual bladder volume ≥100 mL, prostate volume ≥50 mL [30]. The main endpoint of the study was the change in IPSS score relative to baseline.

Comparison of silodosin and placebo among patients with severe LUTS revealed statistically significant differences in favor of the active treatment group compared to the placebo group in terms of improvements in QoL, IPSS, its subscores, and Q_{max}. 53% of patients with severe LUTS and a baseline total IPSS score ≥20 included in a phase III placebo-controlled RPCCT showed an 8–19 improvement in IPSS scores after treatment, 10.2% improved their IPSS score by 0–7 points, and 36.8% showed no significant improvement from baseline. The corresponding figures for patients receiving placebo were 36.6%, 4.8%, and 58.6%. The proportion of patients receiving silodosin who reported improvement (5–6 to 0–4), no effect, and worsening (0–4 to 5–6) of QoL scores was 44.2%, 54.7%, and 1.1%, respectively, and the same rates among patients receiving placebo were 26.4%, 70.6%, and 3.0% ($p = 0.0009$) [30].

Thus, silodosin monotherapy provides statistically significant clinical improvement in the group of patients with severe BOO. These results correlate with the data obtained in the study of patients receiving tamsulosin or alfuzosin, and confirm the favorable pharmacodynamic effect of this class of drugs [30, 32]. It was noted that IPSS scores in patients with severe LUTS against the background of tamsulosin therapy at a dose of 0.4 mg/day improved by an average of 5.8–14.3 points [30].

AB are more effective in severe than in minor manifestations of LUTS [31]. Debruyne et al. [30] found mean improvements in IPSS scores assessing bladder filling and emptying by 1.9 and 3.9 points, respectively, among patients with severe BOO who received tamsulosin at a dose of 0.4 mg/day. These results support the assumption that the effect of AB is mainly to reduce obstruction. Also Debruyne et al. [30] showed an improvement in QoL after 12 months of treatment with tamsulosin 0.4 mg/day. Improvement in Q_{max} was clinically insignificant. This conclusion is consistent with previously published data demonstrating non-significant correlations between improvements in IPSS parameters and changes in Q_{max} results against the background of AB therapy [32].

Incomplete reported data on prostate volume, residual urine volume, adverse events (AEs), and isolated outcomes and consequences constitutes a limitation of the aforementioned RPCCTs [28, 30, 32, 33]. As a consequence, results must be interpreted with caution, since severe BOO symptoms may be associated with late stages of bladder wall remodeling [34].

Nevertheless, it can be concluded that daily AB administration significantly improves QoL against the background of reduced severity of BOO, especially in patients with severe LUTS [23, 33]. In this group, drugs provide a 30–40% reduction in the IPSS score and remain effective for several years [35, 36]. Adverse events associated with the use of alpha-blockers include abnormal ejaculation due to decreased or absent seminal fluid, dizziness, and postural hypotension [35, 36].

In moderate to severe LUTS, prostate volume exceeding 40 cm^3, 5-alpha-reductase inhibitors, dutasteride and finasteride, are prescribed and are associated with a reduced risk of BPH progression against a reduced incidence of acute urinary retention [36–39].

5-alpha-reductase inhibitors help to reduce IPSS by 15–30%, reduce prostate volume threefold from the initial volume, increase in Q_{max} by 1.5–2 ml/s, reduce the risk of acute urinary retention, and reduce the frequency of surgical interventions in a long-term (more than 1 year) run. The effect of this group of drugs comes slower than that of 5-ARIs, and is more noticeable with large prostate volumes. Adverse events observed in patients receiving 5-ARIs, include erectile dysfunction, decreased libido and less often ejaculatory dysfunction, retrograde ejaculation and gynecomastia [23].

Muscarinic receptor antagonists can be used against a background of moderate to severe LUTS, although this group of drugs is associated with increased incidence of acute urinary retention [20, 22–24].

With BPH progression and with large prostate gland volume, large residual urine volume, low Q_{max}, and age >62 years, surgical treatment should be considered [40].

Non-drug methods of treatment of symptomatic BOO in BPH patients who have undergone kidney transplantation

Until the 1970s, the only available treatment and relief for LUTS was open adenomectomy (for very large prostate) or endoscopic surgery in the form of transurethral resection to remove or resect prostatic tissue [41].

In the general population, surgical procedures performed for infravesical obstruction in patients with BPH who have undergone renal transplantation include minimally invasive surgical treatments, such as laser techniques, vaporization techniques, mono- and bipolar resections, open, laparoscopic and robotic adenomectomy, etc. [18, 19, 21, 42, 43].

Transurethral resection of the prostate (TURP) is one of the methods of surgical treatment of BOO against BPH in kidney transplant recipients [44–47]. Against the background of the high efficiency of TURP in controlling LUTS, long-term adverse effects or adverse events, such as erectile and ejaculatory dysfunction, risk of urinary incontinence, and other complications, have been noted [44–48].

Minimally invasive surgical treatments have emerged as an alternative to TURP, successfully reducing BOO symptoms, while minimizing side effects and complications, and reducing the length of hospital stay [43]. These include transurethral electrovaporization (Rezūm technique), transurethral enucleation, laser enucleation, urolifting, and temporary implantable nitinol device [43].

Electrovaporization involves vaporization of the prostate using high-frequency and high-power currents with coagulation of the underlying layers, without capillary bleeding and without coagulation of large vessels and venous sinuses [49, 50]. *Bipolar vaporization* involves simultaneous bipolar resection and vaporization [49, 50].

Rezūm water vapor thermal therapy (Rezūm System, Boston Scientific, Marlborough, Massachusetts) is an innovative minimally invasive surgical treatment approved by the US Food and Drug Administration (FDA) in 2015 to reduce prostate tissue volume associated with BPH, including central zone and/or middle lobe hyperplasia [49–50]. The accumulated thermal energy (540 calories/ml H_2O) is transferred as vapor to the prostate tissue. Thermal effects do not occur beyond the target treatment area [49, 50], thus eliminating the limitations of conductive heat transfer seen in transurethral needle ablation of the prostate (TUNA) and transurethral microwave thermotherapy (TUMT) [51–54].

The most unique feature of this technique is the possibility to influence the lateral and central zones of the prostate gland. Complex anatomical variants, such as intravesical prostatic protrusion, can be treated without affecting sexual function [53]. This technique has been used throughout the United States and Europe for 5 years since FDA approval [49–58]. According to the multicenter, prospective, blinded, controlled trial of water vapor heat therapy (Rezūm II Study, NCT01912339), the wide use of this technique is attributed to sustained relief of LUTS, improved QoL, and long-term response to treatment [49–58]. An RPCCT (Rezūm II Study, NCT01912339) showed that BPH heat therapy has clinically significant results and a proven long-term effect [49, 51–53]. Five years after the procedure, a 30% improvement in IPSS and no recurrence of BPH were found [49–57]. Despite the fact that the majority of patients had pronounced manifestations of LUTS at inclusion in the study (72.5% with IPSS 19–35), these parameters improved in comparison with the initial ones 3 months after a single water vapor heat therapy procedure, without a negative effect on erectile function [49–58].

Other minimal surgical techniques, such as prostatic urethral lift (PUL) or other implantable devices, provide symptomatic relief without tissue removal [59–61]. However, repeated interventions are required to achieve a permanent reduction in LUTS severity with urethral lift surgery [60, 61].

Patients in the general population who may be candidates for water vapor thermal therapy are often referred for more invasive surgical techniques such as TURP, holmium laser enucleation of the prostate, or other treatments that have a high risk of bleeding, longer recovery time, reduced erectile function, and other undesirable side effects [62–65].

In 2018, a study was performed on the long-term outcomes of treatment of lower urinary tract symptoms caused by BPH using a single Rezūm® System water vapor thermotherapy treatment with daily drug therapy: doxazosin and/or finasteride [63]. Thermal therapy resulted in a 50% improvement in IPSS scores at 36 months ($p < 0.0001$). The improvement in symptoms was more pronounced than with one of the drugs, but similar to that with the combined drugs ($p \leq 0.02$ and 0.73, respectively). Q_{max} improved by 4–5 mL per second after thermal therapy and doxazosin, while thermal therapy was superior to finasteride and combination drugs at 24 and 12 months.

Thus, a single session of water vapor thermal therapy provided effective and sustained improvement in symptom scores with a lower observed rate of clinical progression compared with daily long-term use of pharmaceuticals [63].

High-tech methods of LUTS treatment, such as transurethral enucleation of the prostate with a holmium or thulium laser, are now widely used [66–69].

Laser enucleation involves excising the prostate gland up to its surgical capsule, and the enucleated tissue is then moved into the bladder and removed [66–69]. *Holmium laser enucleation of the prostate (HoLEP)* is used for moderate to severe LUTS against a prostate volume exceeding 80 cm^3 [67, 68], and the risk of bleeding against anticoagulant therapy is reduced.

In 2020, data from a multicenter, retrospective pilot comparative study of the efficacy, safety and complications, registered within 1 year, after the following interventions were published: holmium laser enucleation of the prostate, greenlight photoselective vaporization of the prostate (GL-PVP) and TURP performed after KT [70].

From January 2013 to April 2018, 60 BPH endoscopic surgical procedures in KT recipients were performed: 17 patients in the HoLEP group, 9 in the GL-PVP group, and 34 in the TURP group. Age, body mass index, preoperative serum creatinine, preoperative IPSS score, preoperative Q_{max}, preoperative prostate-specific antigen, medical history of acute urinary retention, urinary tract infection and indwelling urethral catheter were similar in all study groups. Mean preoperative prostate volume was higher in the HoLEP group. The rate of overall postoperative complications was statistically higher in the HoLEP group (11/17 [64.7%] vs 1/9 [11.1%] vs 12/34 [35.3%] in HoLEP group, GL PVP group, and TURP group, respectively, p = 0.02). After interventions, Q_{max} were comparably improved in both groups [70].

Considering the above data, it can be concluded that the rate of postoperative complications is higher with HoLEP procedure, in comparison with GL-PVP, for the treatment of BPH after KT [70]. One-year efficacy is similar in HoLEP, GL PVP, and TURP groups [70].

One year later, data from a study was published to compare the efficacy and safety of water vapor thermal therapy using the Rezūm™ system and PUL using the Urolift™ system in men with lower urinary tract symptoms due to BPH [71].

From December 2017 to November 2019, consecutive patients who underwent Rezūm™ and Urolift™ procedures in two urology centers were retrospectively considered. Only patients with a prostate size less than 80 mL were included.

A total of 61 (52.1%) and 56 (47.9%) patients underwent Rezum™ and Urolift™ procedures, respectively. At 12 months, higher IPSS improvement was observed in the Rezum™ group (median:4 [IQR 3–5]) than in the Urolift™ group (median:8 [IQR 7–12]), without statistical difference (p = 0.08). Improvement in QoL at 12 months was similar in the two groups (p = 0.43). Reintervention rates were 25% (Urolift™) and 8.3% (Rezum™), p = 0.24. Erection and ejaculatory function scores did not change significantly in either treatment group.

Results have shown that both Rezum™ and Urolift™ provide clinically significant improvements in symptoms and QoL, although the Rezum™ procedure appeared to be more effective in the immediate and long-term postoperative period [71].

TURP is the gold standard treatment for BPH in 30–80 cm^3 prostate volumes with moderate to severe LUTS [18–21]. *Monopolar TURP* is a well-established option for surgical treatment of BOO due to benign prostatic enlargement. However, this intervention continues to be associated with a significant risk of postoperative complications [72]. In the light of this, new techniques have been developed to reduce the risk of complications. Unlike monopolar TURP, *bipolar TURP* uses energy confined between the active electrode (resection loop) and the return electrode located on the resectoscope tip or sheath, and lower voltage, theoretically eliminating the risk of TURP syndrome and reducing thermal damage to surrounding tissue [72].

Despite existing studies on the efficacy and safety of monopolar and bipolar TURP over the past decade, there remains uncertainty about the differences between these two surgical techniques. Systematic reviews published prior to 2020 that compared these surgical techniques [73–78] did not include a significant number of recently published randomized controlled trials and did not always adhere to strict methodological standards.

A comprehensive systematic electronic literature search was carried out up to 19 March 2019 via CENTRAL, MEDLINE, Embase, ClinicalTrials.gov, PubMed, and WHO ICTRP. Handsearching of abstract proceedings of major urological conferences and of reference lists of included trials, systematic reviews, and health technology assessment reports was undertaken to identify other potentially eligible studies. No language restrictions were applied. Randomized controlled trials, comparing monopolar and bipolar TURP in men (>18 years) for the treatment of LUTS secondary to BPH, were selected.

A total of 59 RPCCTs with 8924 participants were included. The mean age of the included participants was 67 years; mean prostate volume was 39–83 cm^3.

Based on the results of this review, it was shown that bipolar TURP and monopolar TURP relieve LUTS both to a similar degree. Bipolar TURP probably reduces the severity of clinical manifestations of TURP syndrome and postoperative blood transfusion compared to monopolar TURP. The impact of both procedures on erectile function is probably similar. The moderate certainty of evidence available for the primary outcomes of this review suggests that there is no need for further RPCCTs comparing bipolar TURP and monopolar TURP [70]. The most severe complication after prostate gland TURP, with an incidence >7%, is bleeding requiring blood transfusion [70].

In patients in the general population with prostate gland volume <30 cm^3, *transurethral incision* of the prostate (TUIP) [79], in which electrosurgical dissection of the prostate gland tissue is performed using a resectoscope loop, is indicated [79].

According to a small study [80] of the early and long-term outcomes of TURP and TUIP procedures performed in the first month following KT, at a median of 19 days

(range 8–30 days), due to BOO against BPH, no AEs were found.

In the early postoperative period, 5 patients (13.1%) developed urinary tract infection. The mean Q_{max} (22.4 ± 11.1 mL/sec) increased significantly ($p < 0.001$). At the end of follow-up, the groups did not differ in Q_{max} and IPSS scores (P = .89, P = .27, P = .08, and P = .27). Among postoperative complications, the incidence of urinary tract infections and retrograde ejaculation was higher in the TURP than in the TUIP group (12.7% versus 6.2% and 68.1% versus 25%, respectively), whereas urethral strictures were more common in the TUIP group (12.5% versus 6.3%).

Thus, TURP and TUIP techniques have been shown to be equally safe and effective in the surgical treatment of BPH-induced urinary retention in KT recipients with a prostate volume <30 cm^3 [80, 81].

As shown above, prostate volume is the main criterion for choosing the method of surgical treatment of BPH [49–82].

Open adenomectomy is the most effective and unfortunately, the most invasive method of surgical treatment of BPH in patients with a prostate volume >80 cm^3. After this intervention, the effect is most durable [19–21].

Laparoscopic adenomectomy is a minimally invasive surgical procedure that is an alternative to open adenomectomy in patients with a prostate volume ≥90–100 cm^3 [19–21].

TUNA is less effective than TURP among patients in the general population; it is reserved for patients with severe comorbidities, as this procedure does not require hospitalization of the patient and general anesthesia [84].

In *prostate artery embolization*, blood arteries of the prostate gland are occluded by introducing emboli [85, 86]. With this intervention, acute urinary retention episodes are more frequent in the postoperative period [87].

Prostatic stent is used in patients with contraindications to surgical intervention. This procedure is accompanied by a temporary reduction in LUTS and frequent AEs, so its use is limited.

Robotic surgery has shown high efficiency on the background of significant correction of LUTS, exclusion of postoperative complications and fast recovery after surgery [83].

CONCLUSION

The kidney is the most transplantable organ in the world. In the early post-KT period, urinary retention caused by BOO can directly affect the success of transplantation. Accurate assessment and optimal treatment of LUTS in renal transplant candidates and recipients is crucial for improving the QoL and preserving allograft function [88–98].

LUTS should be carefully evaluated before KT. Postoperative symptoms of moderate to severe LUTS should be carefully investigated so that early intervention can prevent graft compromise and associated complications. If indicated, BOO surgery can be performed early after renal transplantation [99–101].

Evidence suggests that many of the proposed treatments for BPH-associated BOO developing after KT can offer effective relief of LUTS. Nevertheless, a number of factors may influence the personalized choice of a particular intervention for each patient. This decision depends on patient characteristics like age, comorbidities, severity of LUTS, concomitant treatment such as ongoing anticoagulant therapy and unpredictable drug interactions. It is necessary to balance the desired results with possible risks. Possible effects on sexual function, frequency of reoperation, and the cost of treatment must be considered.

Despite all the advantages of minimally invasive obstruction therapies, several obstacles limit their wider adoption, the first of which are equipment limitations. For example, urolifting requires a special elongated lens, and Rezūm requires a special computerized radiofrequency steam generator [102].

The second limitation in the new technology is the cost, which is well over €1,000 just for the equipment, in addition to the requirement to perform the procedures in specially designated operating conditions [102]. As cost-benefit analysis has shown, the cheaper minimally invasive methods were €900 more expensive than drug therapy for 2 years [102].

Based on a review of disparate literature data, there is insufficient evidence to offer a reliable recommendation for a specific treatment technique for BOO in all BPH kidney recipients. Further clinical trials with longer follow-up comparing different interventions with routine and evidence-based methods are required.

The authors declare no conflict of interest.

REFERENCES

1. Godovoy otchet o transplantologii v Evrope za 2019 god. https://www.eurotransplant.org/wp-content/uploads/2020/06/AnnualReport-2019.pdf.
2. *Gautier SV, Khomyakov SM.* Donorstvo i transplantatsiya organov v Rossiyskoy Federatsii v 2018 godu. XII soobshchenie Rossiyskogo transplantologicheskogo obshchestva. *Vestnik transplantologii i iskusstvennykh organov*. 2019; 21 (3): 7–32. https://doi.org/10.15825/1995-1191-2019.
3. *Kabanova SA, Bogopol'skiy PM.* Peresadka pochki: istoriya, itogi i perspektivy. *Transplantologiya*. 2015; (2): 49–58.
4. *Sultanov PK, Khadzhibaev FA, Ergashev DN, Ismatov AA*. Analiz oslozhneniy posle transplantatsii pochki. *Vestnik ekstrennoy meditsiny*. 2021; 14 (1): 55–63.
5. *Dos Santos Mantovani M, Coelho de Carvalho N, Archangelo TE, Modelli de Andrade LG, Pires Ferreira Filho S, de Souza Cavalcante R et al*. Frailty predicts surgical complications after kidney transplantation.

A propensity score matched study. *PLoS One*. 2020 Feb 26; 15 (2): e0229531.
6. *Bessede T, Hammoudi Y, Bedretdinova D, Parier B, Francois H, Durrbach A, Benoit G.* Preoperative Risk Factors Associated With Urinary Complications After Kidney Transplantation. *Transplant Proc*. 2017 Nov; 49 (9): 2018–2024.
7. *Hickman LA, Sawinski D, Guzzo T, Locke JE.* Urologic malignancies in kidney transplantation. *Am J Transplant*. 2018 Jan; 18 (1): 13–22.
8. *Shimizu T, Sugihara T, Kamei J, Takeshima S, Kinoshita Y, Kubo T et al*. Predictive factors and management of urinary tract infections after kidney transplantation: a retrospective cohort study. *Clin Exp Nephrol*. 2021 Feb; 25 (2): 200–206.
9. *Thuret R, Timsit MO, Kleinclauss F.* Chronic kidney disease and kidney transplantation. *Prog Urol*. 2016 Nov; 26 (15): 882–908.
10. *Billis A, Freitas LLL, Costa LBE, Barreto IS, Botega AAR, Pereira TA, D'Ancona CA*. Lower Urinary Tract Symptoms Due to Xanthoma of the Prostate After Kidney Transplantation: A Case Report. *Transplant Proc*. 2020 Nov; 52 (9): 2736–2738.
11. *Frascà GM, Brigante F, Volpe A, Cosmai L, Gallieni M, Porta C.* Kidney transplantation in patients with previous renal cancer: a critical appraisal of current evidence and guidelines. *J Nephrol*. 2019 Feb; 32 (1): 57–64.
12. *Tan JHS, Bhatia K, Sharma V, Swamy M, van Dellen D, Dhanda R, Khambalia H.* Enhanced recovery after surgery recommendations for renal transplantation: guidelines. *Br J Surg*. 2022 Dec 13; 110 (1): 57–59.
13. *Thuret R, Kleinclauss F, Terrier N, Karam G, Timsit MO.* Challenges in renal transplantation. *Prog Urol*. 2016 Nov; 26 (15): 1001–1044.
14. *Maggiore U, Abramowicz D, Budde K.* Renal transplantation in the elderly. *Transplant Rev (Orlando)*. 2015 Oct; 29 (4): 191–192.
15. *Rodríguez Faba O, Boissier R, Budde K, Figueiredo A, Taylor CF, Hevia V et al*. European Association of Urology Guidelines on Renal Transplantation: Update 2018. *Eur Urol Focus*. 2018 Mar; 4 (2): 208–215.
16. *Cheung CY, Tang SCW.* An update on cancer after kidney transplantation. *Nephrol Dial Transplant*. 2019 Jun 1; 34 (6): 914–920.
17. *Egan KB.* The epidemiology of benign prostatic hyperplasia associated with lower urinary tractsymptoms: prevalence and incident rates. *Urol Clin North Am*. 2016; 43: 289.
18. *De Oliveira Marinho AC, Tavares-da-Silva E, Bastos CA, Roseiro A, Parada B, Retroz E et al*. Acute Urinary Retention After Kidney Transplant: Effect on Graft Function, Predictive Factors, and Treatment. *Transplant Proc*. 2021 Jul-Aug; 53 (6): 1933–1938.
19. *Sarier M, Yayar O, Yavuz A, Turgut H, Kukul E.* Update on the Management of Urological Problems Following Kidney Transplantation. *Urol Int*. 2021; 105 (7–8): 541–547.
20. *Lerner LB, McVary KT, Barry MJ, Bixler BR, Dahm P, Das AK et al*. Management of Lower Urinary Tract Symptoms Attributed to Benign Prostatic Hyperplasia: AUA GUIDELINE PART I – Initial Work-up and Medical Management. *J Urol*. 2021 Oct; 206 (4): 806–817.
21. *Lerner LB, McVary KT, Barry MJ, Bixler BR, Dahm P, Das AK et al*. Management of Lower Urinary Tract Symptoms Attributed to Benign Prostatic Hyperplasia: AUA GUIDELINE PART II – Surgical Evaluation and Treatment. *J Urol*. 2021 Oct; 206 (4): 818–826.
22. *Kasyan GR, Khodyreva LA, Dudareva AA i dr.* Kombinirovannoe lechenie simptomov nizhnikh mochevykh putey u muzhchin. *Meditsinskiy sovet*. 2016; 5: 84–90.
23. *Seo JH, Han JS, Lee Y, Myong JP, Ha US.* Fall risk related to subtype-specific alpha-antagonists for benign prostatic hyperplasia: a nationwide Korean population-based cohort study. *World J Urol*. 2022 Dec; 40 (12): 3043–3048.
24. *Pushkar' DYu, Rasner PI, Kharchilava RR.* Rossiyskie klinicheskie rekomendatsii s sovremennymi dannymi vedushchikh rossiyskikh spetsialistov. Simptomy nizhnikh mochevyvodyashchikh putey i dobrokachestvennaya giperplaziya predstatel'noy zhelezy. *Urologiya*. 2016; (2, prilozh.): 4–19.
25. *Rasner PI, Gazimiev MA, Gadzhieva ZK i dr.* Rasstroystva mocheispuskaniya u muzhchin: metodicheskie rekomendatsii, № 6. M.: ABV-press, 2017; 35.
26. *Pavlov VN, Galimzyanov VZ, Kazikhinurov AA, Pushkarev AM, Zagitov AR, Kazikhinurova AA, Sharipov IR.* Simptomy nizhnikh mochevyvodyashchikh putey i dobrokachestvennaya giperplaziya predstatel'noy zhelezy: uchebnoe posobie. Ufa: BGMU, 2018; 86.
27. *Foster HE, Dahm P, Kohler TS et al.* Surgical management of lower urinary tract symptom sattributed to benign prostatic hyperplasia: AUA Guideline amendment 2019. *J Urol*. 2019; 202: 592.
28. *Marks LS, Gittelman MC, Hill LA, Volinn W, Hoel G*. Rapid efficacy of the highly selective α1A-adrenoceptor antagonist silodosin in men with signs and symptoms of benign prostatic hyperplasia: pooled results of 2 phase 3 studies. *J Urol*. 2013; 189 (1 Suppl): S122–S128.
29. *Homma Y, Kawabe K, Tsukamoto T et al*. Estimate criteria for diagnosis and severity in benign prostatic hyperplasia. *Int J Urol*. 1996; 3: 261–266.
30. *Debruyne F, Boyle P, Calais Da Silva F et al*. Evaluation of the clinical benefit of permixon and tamsulosin in severe BPH patients – PERMAL study subset analysis. *Eur Urol*. 2004; 45: 773–779.
31. *Razek M, Abolyosr A, Mhammed O, Fathi A, Talaat M, Hassan A.* Prospective comparison of tadalafil 5 mg alone, silodosin 8 mg alone, and the combination of both in treatment of lower urinary tract symptoms related to benign prostatic hyperplasia. *World J Urol*. 2022. Aug; 40 (8): 2063–2070.
32. *Lukacs B, Grange JC, Comet D*. One-year follow-up of 2829 patients with moderate to severe lower urinary tract symptoms treated with alfuzosin in general practice according to IPSS and a health-related quality-of-life questionnaire. *BPM Group in General Practice Urology*. 2000; 55: 540–546.
33. *Barendrecht MM, Abrams P, Schumacher H, de a Rosette JJ, Michel MC*. Do α1-adrenoceptor antagonists improve lower urinary tract symptoms by reducing

bladder outlet resistance? *Neurourol Urodyn*. 2008; 27: 226–230.
34. *Fusco F, Creta M, De Nunzio C et al*. Progressive bladder remodeling due to bladder outlet obstruction: a systematic review of morphological and molecular evidences in humans. *BMC Urol*. 2018; 18: 15.
35. *Gul ZG, Kaplan SA*. BPH: why do patients fail medical therapy? *Curr Urol Rep*. 2019; 20: 40.
36. *La Vignera S, Aversa A, Cannarella R, Condorelli RA, Duca Y, Russo GI, Calogero AE.* Pharmacological treatment of lower urinary tract symptoms in benign prostatic hyperplasia: consequences on sexual function and possible endocrine effects. *Expert Opin Pharmacother*. 2021 Feb; 22 (2): 179–189.
37. *Alcaraz A, Castro-Díaz D, Gacci M, Salonia A, Ficarra V, Carballido-Rodríguez J et al.* Efficacy and Tolerability of 6-Month Treatment with Tamsulosin Plus the Hexanic Extract of Serenoa repens versus Tamsulosin Plus 5-Alpha-Reductase Inhibitors for Moderate-to-Severe LUTS-BPH Patients: Results of a Paired Matched Clinical Study. On Behalf Of The Qualiprost Study Group. *J Clin Med*. 2022 Jun 22; 11 (13): 3615.
38. *Bauer SR, Walter LC, Ensrud KE, Suskind AM, Newman JC, Ricke WA et al*. Assessment of Frailty and Association With Progression of Benign Prostatic Hyperplasia Symptoms and Serious Adverse Events Among Men Using Drug Therapy. *JAMA Netw Open*. 2021 Nov 1; 4 (11): e2134427.
39. *Kuzmenko AV, Kuzmenko VV, Gyaurgiev TA*. Comparative analysis of the effectiveness of early and delayed initiation of combined DRUG therapy for bph. *Urologiia*. 2021 May; (2): 27–30.
40. *Gravas S, Cornu JN, Gacci M et al.* EAU guidelines on management of non-neurogenic male LUTS. Presented at 2020 EAU Annual Congress, Amsterdam, Arnhem, The Netherlands. Available at http://uroweb.org/guidelines/compilations-of-all-guidelines/.
41. *Anderson BB, Pariser JJ, Helfand BT.* Comparison of Patients Undergoing PVP Versus TURP for LUTS/BPH. *Curr Urol Rep*. 2015 Aug; 16 (8): 55.
42. *Drouin S, Defortescu G, Prudhomme T, Culty T, Verhoest G, Doerfler A et al*. Lower urinary tract symptoms and urinary incontinence in renal transplant recipients and candidates: The French guidelines from CTAFU. *Prog Urol*. 2021 Jan; 31 (1): 45–49.
43. *Checcucci E, Veccia A, De Cillis S, Piramide F, Volpi G, Amparore D et al*. New Ultra-minimally Invasive Surgical Treatment for Benign Prostatic Hyperplasia: A Systematic Review and Analysis of Comparative Outcomes. Uro-technology and SoMe Working Group of the Young Academic Urologists Working Party of the European Association of Urology and of the Lower Tract and Research Group of the European Section of Uro-technology. *Eur Urol Open Sci*. 2021 Sep 22; 33: 28–41.
44. *Righetto M, Mancini M, Modonutti D, Calpista A, Beltrami P, Dal Moro F.* Patients with renal transplant and moderate-to-severe LUTS benefit from urodynamic evaluation and early transurethral resection of the prostate. *World J Urol*. 2021 Dec; 39 (12): 4397–4404.
45. *Sarier M, Tekin S, Duman İ, Yuksel Y, Demir M, Alptekinkaya F et al*. Results of transurethral resection of the prostate in renal transplant recipients: a single center experience. *World J Urol*. 2018 Jan; 36 (1): 99–103.
46. *Rassweiler J, Teber D, Kuntz R et al.* Complications of transurethral resection of the prostate (TURP) dincidence, management, and prevention. *Eur Urol*. 2006; 50: 969.
47. *Liu Z, Li YW, Wu WR et al.* Long-term clinicale fficacy and safety profile of transurethral resection of prostate versus plasma kinetic resection of the prostate for benign prostatic hyperplasia. *Urology*. 2017; 103: 198.
48. *Friedl A, Schneeweiss J, Stangl K et al.* The adjustable transobturator male system in stress urinary incontinence after transurethral resection of the prostate. *Urology*. 2017; 109: 184.
49. Boston Scientific Corporation: Intended use. *Rezum Instruction for Use*, 10-2019; 5.
50. *Dixon CM, Rijo Cedano E, Mynderse LA et al.* Transurethral convective water vapor as atreatment for lower urinary tract symptom-atology due to benign prostatic hyperplasiausing the Rezum(R) system: evaluation of acuteablative capabilities in the human prostate. *Res Rep Urol*. 2015; 7: 13.
51. *Bouza C, Lopez T, Magro A et al.* Systematic review and meta-analysis of transurethral needle ablation in symptomatic benign prostatic hyperplasia. *BMC Urol*. 2006; 6: 14.
52. *McVary KT, Rogers T, Mahon J et al.* Is sexual function better preserved after water vapor thermal therapy or medical therapy for lower urinary tract symptoms due to benign prostatic hyperplasia? *J Sex Med*. 2018; 15: 1728.
53. National Institute for Health and Care Excellence: Rezum for treating lower urinary tractsymptoms secondary to benign prostatic hyperplasia (24 June 2020). NICE Guideline No. MTG49.
54. *Mynderse LA, Roehrborn CG, Partin AW et al.* Results of a 5-year multicenter trial of a new generation cooled high energy transurethral microwave thermal therapy catheter for benign prostatic hyperplasia. *J Urol*. 2011; 185: 1804.
55. *Gravas S, Cornu JN, Gacci M et al.* EAU Guidelines on the Assessment of Non-neurogenic Male Lower Urinary Tract Symptoms including Benign Prostatic Obstruction. Arnhem, The Netherlands: EAU Guidelines Office. 2020.
56. *McVary KT, Rogers T, Roehrborn CG.* Rezum water vapor thermal therapy for lower urinarytract symptoms associated with benign prostatichyperplasia: 4-year results from randomized controlled study. *Urology.* 2019; 126: 171.
57. *McVary KT, Roehrborn CG.* Three-year out-comes of the prospective, randomized controlled Rezum System Study: convective radio frequency thermal therapy for treatment of lower urinarytract symptoms due to benign prostatic hyperplasia. *Urology*. 2018; 111: 1.
58. U.S. Food and Drug Administration: Select Up-dates for Guidance for the Non-Clinical and Clinical Investigation of Devices Used for the Treatment of Benign Prosta-

tic Hyperplasia (BPH): Draft Guidance for Industry and Food and Drug Administration Staff (July 14, 2020).
59. *Roehrborn CG, Wilson TH, Black LK.* Quantifying the contribution of symptom improvement to satisfaction of men with moderate to severe benign prostatic hyperplasia: 4-year data from the CombAT trial. *J Urol*. 2012; 187: 1732.
60. *Miller LE, Chughtai B, Dornbier RA et al.* Surgical reintervention rate after prostatic urethral lift: systematic review and meta-analysis involving over 2,000 patients. *J Urol*. 2020; 204: 1019.
61. *Roehrborn CG, Barkin J, Gange SN et al.* Five year results of the prospective randomized controlled prostatic urethral L.I.F.T. study. *Can J Urol*. 2017; 24: 8802.
62. *Zlotta AR, Giannakopoulos X, Maehlum O et al.* Long-term evaluation of transurethral needle ablation of the prostate (TUNA) for treatment of symptomatic benign prostatic hyperplasia: clinical outcome up to five years from three centers. *Eur Urol*. 2003; 44: 89.
63. *Rosario DJ, Phillips JT, Chapple CR.* Durability and cost-effectiveness of transurethral needle ablation of the prostate as an alternative to transurethral resection of the prostate when alpha-adrenergic antagonist therapy fails. *J Urol*. 2007; 177: 1047.
64. *Hill B, Belville W, Bruskewitz R et al.* Transurethral needle ablation versus transurethral resection of the prostate for the treatment of symptomatic benign prostatic hyperplasia: 5-year results of a prospective, randomized, multicenter clinical trial. *J Urol*. 2004; 171: 2336.
65. *Gupta N, Rogers T, Holland B et al.* Three-year treatment outcomes of water vapor thermal therapy compared to doxazosin, finasteride and combination drug therapy in men with benign prostatic hyperplasia: cohort data from the MTOPS trial. *J Urol*. 200; 405: 2018.
66. *Malde S, Rajagopalan A, Patel N et al.* Potassium-titanyl-phosphate laser photoselective vaporization for benign prostatic hyperplasia: 5-year follow-up from a district general hospital. *J Endourol*. 2012; 26: 878.
67. *Lee HE, Kim B, Yoon HS, Suh J, Oh SJ.* Outcome of Patients With Elevated Prostate-Specific Antigen and Lower Urinary Tract Symptoms Receiving Holmium Laser Enucleation of the Prostate. *Int Neurourol J*. 2022 Sep; 26 (3): 248–257.
68. *Takeuchi Y, Sawada Y, Watanabe S, Ni-Itsu Y, Sekido N.* Age-specific effect of transurethral holmium laser enucleation of the prostate on overactive bladder in men with benign prostatic hyperplasia: An investigation using an overactive bladder symptom score. *Low Urin Tract Symptoms*. 2022 Dec 11.
69. *Nohara T, Matsuyama S, Shima T, Kawaguchi S, Seto C.* Holmium Laser Enucleation of the Prostate With Percutaneous Nephrostomy Into the Transplanted Kidney in Patient With Severe Benign Prostatic Hyperplasia With Vesicoureteral Reflux – A Case Report. *Urol Case Rep*. 2015 Dec 10; 4: 33–35.
70. *Prudhomme T, Marquette T, Péré M.* Benign Prostatic Hyperplasia Endoscopic Surgical Procedures in Kidney Transplant Recipients: A Comparison Between Holmium Laser Enucleation of the Prostate, GreenLight Photoselective Vaporization of the Prostate, and Transurethral Resection of the Prostate. *J Endourol*. 2020 Feb; 34 (2): 184–191.
71. *Baboudjian M, Fourmarier M, Gondran-Tellier B, Pradere B, Userovici M, Alegorides C, Barry Delongchamps N.* Head-to-head comparison of prostatic urethral lift and water vapor thermal therapy for the treatment of symptomatic benign prostatic hyperplasia: a real-life study. *Int Urol Nephrol*. 2021 Sep; 53 (9): 1757–1763.
72. *Alexander CE, Scullion MM, Omar MI, Yuan Y, Mamoulakis C, N'Dow JM et al*. Bipolar versus monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database Syst Rev*. 2019 Dec 3; 12 (12): CD009629.
73. *Mamoulakis C, Ubbink DT, de la Rosette JJ.* Bipolar versus monopolar transurethral resection of the prostate: A systematic review and meta-analysis of randomized controlled trials. *Eur Urol*. 2009; 56: 798–809. doi: 10.1016/j.eururo.2009.06.037.
74. *Ahyai SA, Gilling P, Kaplan SA et al.* Meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic enlargement. *Eur Urol*. 2010; 58: 384–397.
75. *Burke N, Whelan JP, Goeree L et al.* Systematic review and meta-analysis of transurethral resection of the prostate vs. minimally invasive procedures for the treatment of benign prostatic obstruction. *Urology*. 2010; 75: 1015–1022.
76. *Omar MI, Lam TBL, Cameron A et al.* Systematic review and meta-analysis of the clinical effectiveness of bipolar compared to monopolar transurethral resection of the prostate. *BJU Int*. 2014; 113: 24–35.
77. *Cornu JN, Ahyai S, Bachmann A et al.* A systematic review and meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic obstruction: An update. *Eur Urol*. 2015; 67: 1066–1096.
78. *Mamoulakis C, Sofras F, de la Rosette J et al.* Bipolar vs. monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction. *Cochrane Database Syst Rev*. 2014; 1: CD009629.
79. *Taylor BL, Jaffe WI.* Electrosurgical transurethral resection of the prostate and transurethral incision of the prostate (monopolar techniques). *Can J Urol*. 2015 Oct; 22 Suppl 1: 24–29.
80. *Sarıer M, Duman İ, Demir M, Yüksel Y, Emek M, Kukul E.* The outcomes of transurethral incision/resection of the prostate (TUIP/TURP) performed early after renal transplantation. *Turk J Urol*. 2018 Mar; 44 (2): 172–177.
81. *Sarier M, Duman I, Kilic S, Yuksel Y, Demir M, Aslan M et al*. Comparative Results of Transurethral Incision with Transurethral Resection of The Prostate in Renal Transplant Recipients with Benign Prostate Hyperplasia. *Urol J*. 2018 Jul 10; 15 (4): 209–213.

82. *Duty BD, Conlin MJ, Fuchs EF, Barry JM.* The current role of endourologic management of renal transplantation complications. *Adv Urol*. 2013; 2013: 246520.
83. *Cardi A, Palleschi G, Patruno G, Tuffu G, D'Amico FE, De Vico A et al.* Robot-assisted simple prostatectomy for treatment of large prostatic adenomas: surgical technique and outcomes from a high-volume robotic centre. *World J Urol*. 2022 Dec 25.
84. *Law YXT, Chen WJK, Shen L, Chua WJ.* Is transurethral needle ablation of prostate out of fashion? Outcomes of single session office-based transurethral needle ablation of prostate in patients with symptomatic benign prostatic hyperplasia. *Investig Clin Urol*. 2019 Sep; 60 (5): 351–358.
85. *Powell T, Rahman S, Staib L, Bhatia S, Ayyagari R.* Operator Learning Curve for Prostatic Artery Embolization and Its Impact on Outcomes in 296 Patients. *Cardiovasc Intervent Radiol*. 2022 Dec 1.
86. *Goyal P, Salem R, Mouli SK*. Controversies in Prostate Artery Embolization: Future Best Practice. *Semin Intervent Radiol*. 2022 Dec 20; 39 (6): 562–570.
87. *Gondran-Tellier B, McManus R, Sichez PC, Akiki A, Gaillet S, Toledano H et al*. Efficacy and Safety of Surgery for Benign Prostatic Obstruction in Patients with Preoperative Urinary Catheter. *J Endourol*. 2021 Jan; 35 (1): 102–108.
88. *Yaremin BI, Kharitonov BI, Mironov AA, Maslikova UV, Aleksandrova VE.* Transplantatsiya pochki – poisk optimal'noy khirurgicheskoy tekhniki. *Vestnik meditsinskogo instituta "REAVIZ"*. 2017; (5): 94–104.
89. *Chadban SJ, Ahn C, Axelrod DA, Foster BJ, Kasiske BL, Kher V et al*. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020 Apr; 104 (4S1 Suppl 1): S11–S103.
90. *Choudhury S, Haldar B, Pal DK.* Spectrum of lower urinary tract symptoms after renal transplant among adult non-urologic anuric patients and their management in a tertiary care center. *Urologia*. 2022 Feb 3: 3915603211048150. doi: 10.1177/03915603211048150.
91. Klinicheskie rekomendatsii Evropeyskoy assotsiatsii urologov [Elektronnyy resurs]. M.: Medkongress, 2019; 1368.
92. Integrativnaya urologiya. Rukovodstvo dlya vrachey / Pod red. P.V. Glybochko, Yu.G. Alyaeva. M.: Medforum, 2014: 128–239, 314–326.
93. *Sánchez-Puy A, Bravo-Balado A, Diana P, Baboudjian M, Piana A, Girón I et al*. New Generation Pulse Modulation in Holmium:YAG Lasers: A Systematic Review of the Literature and Meta-Analysis. *J Clin Med*. 2022 Jun 4; 11 (11): 3208.
94. *Perri A, Izzo G, Lofaro D, La Vignera S, Brunetti A, Calogero AE, Aversa A.* Erectile Dysfunction after Kidney Transplantation. *J Clin Med*. 2020 Jun 25; 9 (6): 1991.
95. *Kleinclauss F, Thuret R, Murez T, Timsit MO.* Urologic malignancies in renal transplant candidates and recipients. *Prog Urol*. 2016 Nov; 26 (15): 1094–1113.
96. *Danovich MG.* Transplantatsiya pochki. Per. s angl. pod red. Ya.G. Moysyuka. M.: GEOTAR Media, 2014; 848.
97. *Latchamsetty KC, Mital D, Jensik S.* Use of collagen injections for vesicoureteral reflux in transplanted kidney. *Transplant Proc*. 2003; 35: 1378.
98. *Li Marzi V, Filocamo MT, Dattolo E*. The treatment of fistulae and ureteral stenosis after kidney transplantation. *Transplant Proc*. 2005; 37: 2516.
99. *Mokos I, Kastelan Z, Basić-Jukić N, Kes P, Pasini J.* Transurethral incision/resection of the prostate (TUIP/TURP) in operative treatment of repeated bladder outlet obstruction early after kidney transplantation. *Acta Clin Croat*. 2011 Sep; 50 (3): 381–384.
100. *Védrine N, Nsabimbona B, Soares P, Deteix P, Boiteux JP, Guy L.* Transurethral resection or incision of the prostate in the immediate postoperative follow-up of renal transplantation. *Prog Urol*. 2009 Dec; 19 (11): 845–849.
101. *Gratzke C, Pahde A, Dickmann M, Reich O, Seitz M, Jauch K et al*. Predictive factors for urinary retention following kidney transplantation in male patients. *Scand J Urol Nephrol*. 2012 Feb; 46 (1): 44–47.
102. *Gill BC, Ulchaker JC.* Costs of managing benign prostatic hyperplasia in the office and operating room. *Curr Urol Rep.* 2018; 19: 72.

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