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Evaluation of the clinical efficacy of transurethral bipolar surgery and laser technologies in the treatment of patients with benign prostatic hyperplasia

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ABSTRACT

BACKGROUND: Benign prostatic hyperplasia (BPH) is common middle-aged and elderly men. In modern urology, transurethral resection and its modifications are used in surgical treatment of BPH. In the last decades, an active tendency of laser technologies development in urology was noted. The search for the most appropriate techniques of transurethral removal of prostate adenoma by comparing the results of treatment of patients with the use of different technologies remains relevant.

AIM: This study aimed to evaluate the clinical effectiveness of transurethral bipolar surgery and laser technologies in the treatment of BPH.

MATERIALS AND METHODS: Transurethral enucleation of the prostate using various technologies was performed in 273 patients with BPH between 2021 and 2023: 94 patients underwent bipolar transurethral enucleation of the prostate, 87 underwent thulium enucleation of the prostate (ThuLEP), and 92 underwent holmium enucleation of the prostate (HoLEP).

RESULTS: Clinical evaluation showed the absence of intraoperative complications. For ThuLEP, a trend toward shorter operative times compared to other techniques was observed. In the early postoperative period, significant bleeding was noted in six cases of using bipolar technology, three cases of using a thulium laser, and five cases of using a holmium laser. An examination of patients 6 months postsurgery showed pronounced positive dynamics in all three groups. No significant differences were found in clinical parameters 6 months postsurgery in patients of different groups.

CONCLUSIONS: Bipolar enucleation of the prostate, ThuLEP, and HoLEP are comparable in effectiveness and the number of complications in the surgical treatment of BPH. Study results indicated that it is advisable to actively use these methods in wide clinical practice.

Keywords: benign prostatic hyperplasia; transurethral bipolar enucleation of the prostate; holmium enucleation of the prostate; thulium enucleation of the prostate; HoLEP; ThuLEP.

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Оценка клинической эффективности трансуретральной биполярной хирургии и лазерных технологий в лечении пациентов с доброкачественной гиперплазией предстательной железы

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АННОТАЦИЯ

Актуальность. Доброкачественная гиперплазия предстательной железы — широко распространенное заболевание среди мужчин среднего и пожилого возраста. В современной урологии в оперативном лечении этого заболевания применяется трансуретральная резекция и ее модификации. В течение последних десятилетий наблюдается активная тенденция развития лазерных технологий в урологии. Актуальным остается поиск наиболее совершенных методик трансуретрального удаления аденомы простаты путем сравнения результатов лечения пациентов с применением различных технологий.

Цель — оценка клинической эффективности трансуретральной биполярной хирургии и лазерных технологий в лечении пациентов с доброкачественной гиперплазией предстательной железы.

Материалы и методы. Трансуретральная энуклеация предстательной железы с применением различных технологий была выполнена 273 пациентам с доброкачественной гиперплазией предстательной железы в период с 2021 по 2023 г.: 94 — биполярная трансуретральная энуклеация предстательной железы, 87 — тулиевая энуклеация простаты (ThuLEP), 92 — гольмиевая энуклеация простаты (HoLEP).

Результаты. Клиническая оценка результатов трансуретральной энуклеации показала отсутствие интраоперационных осложнений. Для ThuLEP отмечена тенденция к меньшей продолжительности операции по сравнению с остальными методиками. В раннем послеоперационном периоде значимое кровотечение отмечено в 6 случаях применения биполярной технологии, в 3 случаях — тулиевого лазера и в 5 случаях — гольмиевого лазера. Проведенное обследование больных через 6 мес. после операции показало выраженную положительную динамику во всех трех группах. Статистически значимых различий клинических показателей через 6 мес. после оперативного вмешательства у пациентов разных групп не отмечено.

Заключение. Биполярная энуклеация простаты, ThuLEP и HoLEP сопоставимы по эффективности и количеству осложнений при хирургическом лечении доброкачественной гиперплазии предстательной железы. Полученные результаты позволяют сделать вывод о целесообразности активного применения данных методов в широкой клинической практике.

Ключевые слова: доброкачественная гиперплазия предстательной железы; трансуретральная биполярная энуклеация простаты; гольмиевая энуклеация простаты; тулиевая энуклеация простаты; HoLEP; ThuLEP.

Как цитировать

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BACKGROUND

Benign prostatic hyperplasia (BPH) is one of the leading urological diseases in men aged 40 years and is characterized by infravesical obstruction and symptoms of the lower urinary tract [1–4]. As the prostate gland enlarges in the absence of timely treatment, the risk of complications increases, including acute urinary retention, hematuria, recurrent urinary tract infection, cystolithiasis, and impaired renal function [3, 4].

The application of the principles of evidence-based medicine and an interdisciplinary approach has advanced the development of prostate surgery. The gold standard of surgical treatment for patients with BPH is transurethral resection of the prostate (TURP) and its modifications, which provide similar results with less trauma and rehabilitation time [5]. The use of monopolar TURP is justified when the volume of the prostate gland is <80 cm^3, and bipolar TURP allows removal of larger glands [5]. However, when performing TURP, complications specific to the procedure are noted: TUR syndrome and bleeding during and after surgery [6]. With an expected TURP duration of >90 minutes, the risk of complications increases significantly, especially in patients with impaired urodynamics of the upper urinary tract and older individuals [7]. The recurrence rate after TURP is 5%–15% [8].

The development of medical technologies, as well as the desire of clinicians to minimize complications, has led to the introduction of new surgical treatment methods for BPH. The traditional TUR is being replaced by endoscopic enucleation using various energy sources, which makes it possible to operate on patients with prostate hyperplasia of any size [9–11]. Along with bipolar energy, the use of laser technologies in prostate surgery has become possible, the most famous of which are holmium and thulium lasers. The first surgical experience of using holmium laser in patients with BPH was described by a group of New Zealand urologists led by Gilling in the late 1990s [12]. In 2010, Herrmann et al. [13] presented the results of thulium enucleation of the prostate to the medical community. Studies of the problem of surgical treatment of patients with BPH are largely aimed at unifying the stages of surgical treatment; however, the optimal surgical method of treatment in a multidisciplinary hospital remains unclear.

This study aimed to clinically evaluate transurethral enucleation of the prostate gland performed using various energy sources.

MATERIALS AND METHODS

The results of surgical treatment of 273 patients with BPH (average age: 67 years) who underwent transurethral bipolar or laser enucleation of the prostate between 2021 and 2023 were investigated. The design of the research study included three stages. First, the informativeness of modern methods of diagnosing BPH was studied, which made it possible to determine the feasibility of surgical treatment. Second, a comprehensive assessment of the results of transurethral enucleation of the prostate gland was performed. Third, the intra- and postoperative complications of transurethral interventions were assessed.

Examination of patients with BPH began at the outpatient stage, which included determination of the level of prostate-specific antigen, finger rectal examination, ultrasound examination with determination of prostate volume and amount of residual urine, uroflowmetry, and assessment of symptoms according to the International Prostate Symptom Score (IPSS) questionnaire and of quality of life according to the Quality of Life (QoL) questionnaire. Additionally, with elevated levels of prostate-specific antigen, magnetic resonance imaging and, if necessary, transrectal biopsy of the prostate were performed to exclude prostate cancer.

When indications for surgery were identified, patients with BPH underwent transurethral surgery. According to the types of energy used, three groups of patients were identified. Group 1 included 87 patients aged 57–79 years (average: 67.8 years), with a prostate volume of 51–125 cm^3 and total IPSS score of 20–31, who underwent thulium laser enucleation of the prostate (ThuLEP). Group 2 consisted of 92 patients aged 55–79 years (average: 67 years), with a prostate volume of 64–175 cm^3 and total IPSS score of 23–33, who underwent holmium laser enucleation of the prostate (HoLEP). Group 3 included 94 patients aged 56–78 years (average: 66.3 years), with a prostate volume of 42–105 cm^3 and total IPSS score of 21–32, who underwent bipolar TURP.

The surgical stage of treatment included diagnostic urethrocystoscopy, which allowed the assessment of the condition of the urethra and neck and mucous membrane of the bladder, location of the ureteral orifices, and size of the prostate gland (Fig. 1). The next stage was “entering the layer”: incision in the neck of the bladder until the fibers of the prostate capsule were reached, followed by enucleation of adenomatous nodes (Fig. 2). The final stage was the morcellation of hyperplasia nodes. All surgical procedures were performed under spinal anesthesia.

The Auriga XL 50W (Boston Scientific Corporation, USA) and FiberLase U2 (Russia) laser units, Autocon III 400 high-frequency generator (Karl Storz, Germany), and Karl Storz bipolar resectoscope (Germany) were used for the surgical procedures.

Dynamic follow-up of patients in the early postoperative period and a control outpatient examination 6 months after surgery were performed to assess the effectiveness of surgical treatment.

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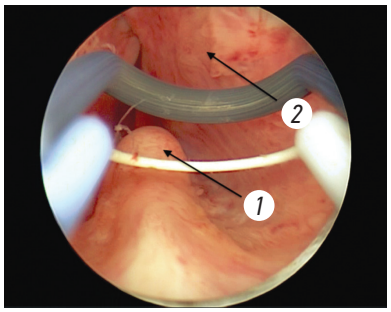

Fig. 1. Urethroscopy for bipolar enucleation of the prostate. *1*, seminal tubercle; *2*, adenomatous node of the left lobe of the prostate
Рис. 1. Уретроскопия при биполярной энуклеации предстательной железы. *1* — семенной бугорок, *2* — аденоматозный узел левой доли предстательной железы

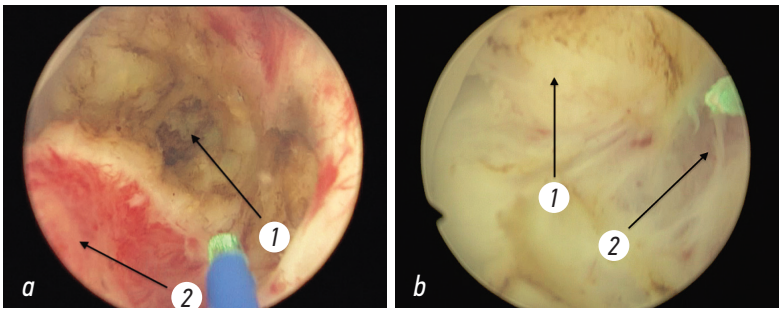

Fig. 2. Stages of laser enucleation of the prostate: *a*, incision of the mucosa (*1*) behind the seminal tubercle (*2*); *b*, dissection of prostate tissue (*1*, adenomatous tissue; *2*, prostate capsule)
Рис. 2. Этапы лазерной энуклеации предстательной железы: *a* — инцизия слизистой оболочки (*1*) позади семенного бугорка (*2*); *b* — диссекция ткани простаты (*1* — аденоматозная ткань, *2* — капсула простаты)

Data were statistically analyzed using the Statistica v. 10.0 software package. The arithmetic mean (*M*) and average error of the arithmetic mean (*m*) were used to describe the quantitative variables. The differences were considered significant at $p < 0.05$.

RESULTS

Table 1 presents the main indicators characterizing the performed operative treatment. No significant differences were noted in the average weight of the removed prostate tissue, average duration of operations, and duration of hospitalization. Moreover, a gradual decrease in the time of surgical interventions was observed as the experience of surgeons improved.

All patients were fitted with a three-way 18 Ch Foley urethral catheter for 2–4 days after surgery. The average length of stay of patients in the hospital after the intervention was 2–6 days. Longer intervention and urethral catheter retention times were noted in patients after bipolar intervention, which may be attributed to the greater traumatizing effects of this type of energy compared to laser technologies.

Intraoperative complications were absent in all the operated patients. Analysis of complications in the early postoperative period (the first 3–5 days) showed the following results: grade I complications according to the Clavien–Dindo classification (irritative and hemorrhagic symptoms associated with the installation of drains into the urinary tract — a three-way urethral catheter) were noted in 21 (7.7%) patients; grade II (clinically significant macrohematuria requiring active hemostatic therapy) in 14 (5.1%) and in 6 (6.9%) cases when using the bipolar technique, in 3 (3.2%) after using a thulium laser, and in 5 (5.3%) after HoLEP; and grade III (bladder tamponade requiring repeated revision of the lower urinary tract with endoscopic hemostasis) in 3 (3.4%) patients after bipolar resection. Complications of IV and V degrees were not noted. Within 6 months after surgery, 13 (4.7%) patients showed symptoms of an overactive bladder: 2 (2.3%) patients from group 1, 4 (4.3%) from group 2, and 7 (7.4%) from group 3. Differences in the incidence of complications in patients of different groups were not significant ($p > 0.05$). Total urinary incontinence and the development of urethral stricture were not detected in any patient.

Examination of patients 6 months after surgery showed pronounced positive dynamics in all three groups. A significant decrease was found in the severity of urination disorders according to the IPSS questionnaire, as well as an improvement in the quality of life on the QoL scale, an increase in the urine flow rate (Q_{max}), and a decrease in the volume of residual urine. No significant differences were observed in clinical parameters 6 months after surgery in patients of the different groups.

DISCUSSION

Transurethral enucleation of the prostate gland is increasingly recognized as an effective minimally invasive surgical method for the treatment of patients with BPH. To compare the effectiveness of various types of transurethral enucleation, scientific publications on this problem were studied and the database of the urological hospital of the State Budgetary Healthcare Institution "Municipal Clinical Hospital No. 13 of the Moscow Department of Health" was analyzed.

In 2017, Enikeev et al. revealed the results of a comparative analysis of the effectiveness of monopolar electroenucleation and previously described laser techniques of prostate enucleation [14]. They showed that HoLEP allows to achieve results that are not inferior to monopolar electrosurgery and open adenomectomy with a lower

Table 1. Perioperative indicators and duration of hospitalization in patients of different groups, $M \pm m$ ($n = 273$)

Таблица 1. Периоперационные показатели и продолжительность госпитализации у пациентов разных групп, $M \pm m$ ($n = 273$)

Group	Prostate volume before surgery, cm^3	Mass of the removed prostate tissue, g	Duration of the operation, minutes	Duration of hospitalization, days
Group 1 ($n = 87$)	89.8 ± 23.3	71.8 ± 18.5	72.4 ± 21.9	3.0 ± 0.8
Group 2 ($n = 92$)	83.7 ± 32.1	66.1 ± 25.3	74.4 ± 20.7	3.4 ± 1.4
Group 3 ($n = 94$)	73.6 ± 18.7	58.8 ± 15.1	81.4 ± 25.2	3.7 ± 1.2

Note. No significant differences were found between groups ($p < 0.05$).
Примечание. Статистически значимых различий между группами не выявлено ($p < 0,05$).

Table 2. Clinical parameters before and 6 months after surgery in patients of different groups, $M \pm m$ ($n = 273$)

Таблица 2. Клинические показатели до и через 6 мес. после операции у пациентов разных групп, $M \pm m$ ($n = 273$)

Indicator	Group 1 ($n = 87$)	Group 2 ($n = 92$)	Group 3 ($n = 94$)
IPSS, points			
• before the operation	25.5 ± 3.3	28.9 ± 3.1	27.4 ± 3.5
• 6 months after	9.6 ± 1.6*	11.8 ± 2.1*	10.4 ± 1.6*
QoL, points			
• before the operation	4.6 ± 0.5	4.6 ± 0.5	4.5 ± 0.5
• 6 months after	1.4 ± 0.8*	2.0 ± 0.5*	2.1 ± 0.8*
Q_{max}, ml/s			
• before the operation	7.4 ± 0.7	7.3 ± 0.7	8.7 ± 0.6
• 6 months after	19.2 ± 2.6*	15.3 ± 2.7*	14.1 ± 2.0*
Volume of residual urine, ml			
• before the operation	106.9 ± 13.3	95.9 ± 14.2	86.5 ± 7.6
• 6 months after	11.2 ± 6.4*	15.6 ± 9.3*	15.4 ± 8.6*

*Differences with preoperative values are significant ($p < 0.05$).
*Различия с показателями до операции статистически значимы ($p < 0,05$).

incidence of complications. According to the authors, with the high efficiency of thulium and holmium enucleation, they can be considered the gold standard in the treatment of patients with prostate hyperplasia. In the authors' study, no differences were noted in the duration of postoperative bladder catheterization and length of hospitalization when these techniques were used. Moreover, on average, the duration of thulium enucleation was less than that of holmium enucleation. The obtained data confirm these conclusions. Despite the higher incidence of complications noted in our study, monopolar prostate enucleation is a promising addition to various enucleation techniques that have been proven effective. The results of the present study indicate that the use of bipolar enucleation, ThuLEP, and HoLEP provides a comparable improvement in the symptoms and quality of urination in the postoperative period in patients with symptoms of the lower urinary tract caused by BPH. In the present study, no significant differences were observed in the peri- and postoperative management of patients when using these techniques. All three mentioned methods of enucleation are safe and effective for the treatment of patients with symptomatic BPH, with a lower risk of bleeding and TUR syndrome and a short postoperative period, catheterization time, and hospital stay. Enucleation techniques are associated with longer working times and have a steep learning curve. The choice of enucleation method should be based on the experience of the operator and accessibility for the surgeon.

Considering the wide prevalence and social significance of the problem of BPH in middle-aged and elderly men, the priority direction of modern medicine is the continuation of scientific research in the field of personalized approach to the choice of tactics of management and possible surgical treatment of the patient.

CONCLUSION

Bipolar enucleation, ThuLEP, and HoLEP were comparably effective in the surgical treatment of patients with BPH. ThuLEP has a shorter duration of surgery compared to other methods.

Summarizing the modern world experience and domestic achievements of recent decades in the surgery of patients with BPH, it should be noted that modern approaches and the introduction of new surgical treatment methods into clinical practice increase the effectiveness of treatment, reduce the risk of complications, and improve the QoL of patients. Methods of endoscopic prostate enucleation are becoming a new standard in BPH treatment, and a significant number of surgical methods make them available to various hospitals.

ADDITIONAL INFORMATION

Authors' contribution. Thereby, 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: S.I. Suleymanov — concept and design of the study, analysis of the data obtained, editing the text of the manuscript; A.S. Babkin, D.A. Fedorov — collection of material, literature data analysis, analysis of the data obtained, writing the text of the manuscript; A.M. Aguzarov, Z.I. Ashurov, K.K. Bagaturiya, V.V. Musohranov, A.A. Tyagun — collection of material, analysis of the obtained data, editing the text of the manuscript.

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Conflict of interests. The authors declare no conflict of interest.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

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