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**ASSESSEMENT OF POSTOPERATIVE COMPLICATIONS OF
DIFFERENT SURGICAL METHODS IN THE TREATMENT OF
BENIGN PROSTATIC HYPERPLASIA: A STANDARTISED
APPROACH**

Monograph

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The monograph reflects the main theoretical and practical aspects of surgical treatment of benign prostatic hyperplasia (BPH). Much attention is paid to various methods of surgical treatment of BPH. An improved classification system of postoperative complications of different surgical methods in the treatment of BPH with criteria for uncomplicated and complicated course of the postoperative period was presented. It has been determined that for an objective assessment of the quality of surgery performed for BPH, an adequate assessment of postoperative complications is necessary in accordance with these criteria.

The monograph is intended for urologists, master's degree residents, clinical residents and medical students.

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List of abbreviations

AP	–	acute pyelonephritis
ASA	–	American Society of Anesthesiologists
AUR	–	acute urinary retention
BPH	–	benign prostatic hyperplasia
CP	–	chronic pyelonephritis
CUR	–	chronic urinary retention
CVS	–	cardiovascular system
HoLEP	–	Holmium Laser Enucleation of the Prostate
IPSS	–	International Prostate Symptom Score
IVO	–	infravesical obstruction
LUTS	–	lower urinary tract symptoms
OPA	–	open prostate adenomectomy
PSA	–	prostate-specific antigen
PVR	–	post-void residual (residual urine volume)
QoL	–	quality of life
SC	–	surgical complications
ThuLEP	–	thulium laser enucleation of the prostate
TRUS	–	transrectal ultrasound
TURP	–	transurethral resection of the prostate
TWOC	–	trial without catheter
US	–	ultrasonography
UTI	–	urinary tract infection

INTRODUCTION

Benign prostatic hyperplasia (BPH), as defined by the American Urological Association (AUA), is a histological diagnosis referring to the proliferation of smooth muscle and epithelial cells in the transitional zone of the prostate gland. The transitional zone makes up about 5% of the entire prostate and surrounds the proximal urethra. This zone is characterized by constant growth throughout a man's life [1]. At the population level, there is a trend towards a sharp increase in the prevalence of BPH, which is associated with the aging of the population [2,3].

Clinically, the presence of BPH in middle-aged, elderly and senile men is closely associated with the development of lower urinary tract symptoms (LUTS), which include urgency, nocturia, urinary frequency, dysuria, difficulty emptying the bladder, difficulty initiating urination, decreased flow or intermittent urination. The appearance and persistence of LUTS are most often associated with BPH and its complications. Therefore, the European Association of Urology (EAU) considers BPH in the context of its associated LUTS and is considered a non-neurogenic cause causing benign prostatic obstruction (BPO) [4].

Unfortunately, effective medications actively used in recent decades in the treatment of LUTS caused by BPH have not completely solved the problem. Due to continuous progression of the disease and refractoriness to medical treatment, as well as due to patient's preferences, need for surgical treatment of BPH still remains high.

More than 100 years have passed since the radical adenectomy of the prostate was proposed by P. Freyer (1901) [5,6] and S.P. Fedorov (1909) [7]. Open prostate adenectomy (OPA) followed by transurethral resection of the prostate (TURP). It has traditionally been considered as "gold standard" of surgical treatment for BPH [8].

TURP is currently the most common surgical method for removal medium- to large-sized adenomas. It is generally effective in relieving bladder outlet obstruction (BOO) caused by BPH. However, with TURP, hyperplastic tissue is resected in sections, and bleeding may occur with any cut. This usually requires repeated coagulation and is time-consuming, which significantly limits the effectiveness of TURP, especially for large adenomas. On the other hand, OPA allows complete

enucleation of the adenoma within the surgical capsule. This ensures radical removal of the adenoma and significantly increases efficiency, especially for large adenomas. However, open surgery by its nature is characterized by a greater risk of perioperative complications and a longer recovery period [9].

The disadvantages mentioned above and limitations of TURP and OPA have led to the search for new alternative transurethral methods of surgical treatment, one of which, is holmium laser enucleation of the prostate - HoLEP (Holmium Laser Enucleation of the Prostate) [10].

HoLEP is the modality of choice for large prostates bigger than 80 cm³, because it has a number of advantages over TURP. OPA and bipolar enucleation of the prostate are also could be offered to patients with big prostate volume [3]. In addition, HoLEP as a “size-independent” procedure, i.e. applicable for prostatic hyperplasia of any volume [10,11,12].

Nowadays in those centers where available technologies and specialists allow, traditional open surgery for BPH has been replaced by transurethral endoscopic interventions. EAU experts recommend to offer OPA to patients with moderate or severe LUTS due to BPH and prostate volume more than 80 ml in situations when bipolar transurethral enucleation of the prostate or HoLEP is not possible [3].

However, in some centers open surgery for BPH is still a popular and necessary option. This may be due to the lack of necessary equipment, as well as the stage of initial mastering modern transurethral methods of surgical treatment of BPH. Open surgery is applicable in clinical situations when BPH is associated with urinary bladder stones or bladder diverticulum [13,14].

Appearance of HoLEP technology in 1998 has started the era of anatomical endoscopic enucleation of the prostate (AEEP) methods in the surgical treatment of BPH. The emergence and spread of high-tech and effective AEEP technologies, in particular, bipolar enucleation of the prostate, ThuLEP (Thulium Laser Enucleation of the Prostate), etc. gave rise to a large number of investigations devoted to assessing the effectiveness and safety of these interventions. New techniques were compared with the current “gold standard” - TURP, traditional non-endoscopic - open prostate adenectomy and, of course, with each other [10].

A number of studies have compared TURP with HoLEP. A large systematic review and meta-analysis was devoted to comparison the efficacy and safety of bipolar TURP with HoLEP. It was obtained that both techniques are safe and equally effective in eliminating LUTS in patients [15]. In a study comparing monopolar TURP and HoLEP, similar postoperative results were noted in both groups, with slightly longer operative time in the HoLEP group [16]. A systematic review conclusively demonstrated that there were no clinically significant differences in early and late postoperative complications between the two techniques. Although operation time was lower in the TURP group, HoLEP demonstrated better safety profile due to more pronounced clinical efficacy and low rate of hemotransfusions, as well as shorter catheterization times and hospital stays [10,16].

Meta-analyses comparing HoLEP with OPA report similar effectiveness of both techniques. Despite longer operative time and less tissue resected, HoLEP is characterized by significantly less blood loss and shorter catheterization and hospital stay times. With regard to the development of postoperative urethral strictures, stress urinary incontinence, blood transfusion requirements, and re-intervention rates, HoLEP and OPA have comparable safety [12,17]. However, HoLEP also has its own complication profile and is associated with higher rates of urge urinary incontinence in the early postoperative period compared to TURP (44% vs. 38.6%, respectively). HoLEP, like TURP, is characterized by high rates of postoperative retrograde ejaculation [1,18].

There are studies analyzing all three methods. A meta-analysis by Chinese scientists [19] showed the advantages of HoLEP due to the low incidence of perioperative complications and faster rehabilitation after surgery compared to TURP and OPA. In a study by Italian scientists comparing the costs of HoLEP, TURP and OPA, the HoLEP procedure turned out to be the most cost-effective due to the reduction in indirect costs, primarily due to the short hospitalization time [20]. The disadvantages of many studies were the lack of comparison of results taking into account the initial risk of intervention according to ASA, as well as incorrect systematization of postoperative complications or its absence.

Classification of complications according to Clavien-Dindo (2004) [21] intended for systematization and objective assessment of any types

of postoperative complications approved by the European Association of Urology and its use is recommended for assessing treatment results in urological practice[3]. Sagen E. et al. [22], Zhao C.B. et al. [19] applied Clavien-Dindo classification system to assess complications of TURP. Yalcin S. et al. used the Clavien system for assessment of complications after HoLEP [23]. Other authors, without systematizing complications, compared the results HoLEP, TURP and OPA [20], and HoLEP with plasmakinetic enucleation [24].

Analysis of the research results showed that the practice of template application of this classification, without adapting it withtaking into account the specifics of the disease and the goal pursued as a result of surgery, usually leads to inaccuracies in the objective assessment of complications [25-30].

CHAPTER I. MODERN VIEWS ON BPH. HISTORY OF THE DEVELOPMENT OF SURGICAL TREATMENT METHODS FOR BPH

1.1. Etiology and pathogenesis of BPH

Benign prostatic hyperplasia (BPH or prostatic adenoma) with associated lower urinary tract symptoms, complications and disturbances in the quality of males' life have been an urgent medical problem for many centuries and continues to be a problem of modern medicine. Considering that the disease develops mainly in men over 45-50 years of age, its frequency is related to the life expectancy of the population in each specific country. The results of epidemiological studies in recent years indicate an obvious trend towards an aging of the population. If in the 18th century the average life expectancy was 45 years, then by the beginning of the 21st century in Europe and North America it was 72 years and continues to grow [31]. According to United Nations (UN) forecasts, by 2025 there will be 8.3-8.5 billion people living on our planet. From the second half of the 20th century humanity is aging quickly. If in 1950 the number of elderly people (65 years and older) was about 128 million, then by 2000 their number reached 419 million (6.8% of the total population). By 2050 the number of older people will be about 1.5 billion, which will correspond to 14.7% of the total population [32,33].

Causal treatment of any disease leads to successful and effective results. But, unfortunately, the question of the etiology of BPH is currently not fully understood by scientists, although a colossal amount of knowledge and experience in this direction has been accumulated. According to Isaacs J.T. et al. (1989) the number of cells and the size of the prostate gland directly depend on the balance between the processes of proliferation and programmed cell death (apoptosis) [34]. From this it becomes clear that an organ can increase either by accelerating the rate of hyperplasia or by slowing down apoptosis. And if the disruption process develops in both directions, then rapid or rapid growth will be observed. Morphological studies have proven that with BPH, hyperplasia occurs due to both an increase in glandular tissue and stromal tissue [35], but in each specific case the ratio of these tissues in the formation may be different. Scientific data in recent years show that

fibroblast growth factors (FGF) 2 and 9 have a stimulating effect on prostate stromal cells [36-37], insulin-like growth factors (IGF) I and II have mitogenic activity in stromal cells [40], and also data on transforming growth factors (TGF) β 1, which at certain concentrations possibly suppress the process of apoptosis [41]. On the other hand, there is a lot of evidence about the role of hormones - androgens and estrogens in the development of BPH, when the androgen/estrogen ratio in the prostate tissue changes with age in a man, as well as the presence of hereditary and genetic factors. All this leads to an increase in the number of cells in the transitional zone and periurethral part of the prostate gland (the so-called stromal part of the prostate), which leads to mechanical and functional disorders of urination, up to its complete cessation.

All of the above, in turn, suggests that for each man, the etiological trigger for the development of BPH may be various reasons, including individual hormonal and immune status. Therefore, we can conclude that today there is no etiotropic treatment for BPH and urologists do not have the opportunity to radically influence the cause of the development of prostate hyperplasia. And we are forced to carry out symptomatic treatment, both with drug treatment and performing surgical interventions to remove the adenoma.

1.2. History of the development of approaches to the surgical treatment of BPH

Increasing life expectancy and an aging of the population are leading to an increase in the prevalence of males with severe lower urinary tract symptoms (LUTS) symptoms due BPH. Such characteristics of patients as elderly and senile age, severe concomitant diseases require effective and safe treatment that alleviates the symptoms of the disease and improves the quality of life. A modern man at any age strives to maintain the quality of his life. Diagnosis and treatment of BPH is not only a serious medical, but also a major social problem [42]. Consequently, timely examination, diagnosis of the disease and competent treatment, which includes the prevention of complications, plays big role in the effectiveness of treatment and improving the quality of life.

An analysis of the history of approaches to the treatment of BPH shows that until the middle of the 17th century, medical workers considered the presence of bladder and urethral stones to be the main cause of urinary retention. Only in 1648, the French physician Jean Riolan suggested that it was the enlargement of the prostate gland (adenoma) leading to the infravesical obstruction (IVO), which is the cause of urinary disorders development of [43]. In the 18th century, Giovanni Batisto Morgagni developed ideas about this disease and made an invaluable contribution to the development and beginning of surgical treatment of prostate adenoma [44]. An analysis of the approach to the treatment of prostate adenoma shows that even by the middle of the 19th century, not all doctors agreed with the theories that prostate hyperplasia is the cause of BOO.

British surgeon Henry Thompson wrote in 1861 [45] that the treatment of patients with BPH was carried out in three main areas: the first included general recommendations regarding the lifestyle of patients, taking into account the list of foods that could be taken or undesirable for taking; second – treatment recommendations aimed at reducing the size of prostate adenoma, which included both medications and the possibility of surgical removal of the tumor; the third is treatment, including the fight against complications of prostate adenoma - urinary tract infection, stone formation, and in case of pronounced large stones, surgical removal of the stone. The author at one time admitted that, unfortunately, there are no effective drugs to effectively reduce prostate adenoma. In cases of urinary retention, bladder catheterization was suggested, followed by self-catheterization. If it is impossible to perform catheterization, various methods of surgical diversion of urine have been proposed. According to G. Thompson, who preferred transrectal access for urine diversion, with successful access and urine diversion, the patient can still live for quite a long time, i.e. 2-3 months [45]. This was the sad fate of patients with prostate adenoma until the end of the 19th and beginning of the 20th centuries, and, in fact, treatment of prostate adenoma included a mostly futile fight against its complications. BPH was considered a life-threatening disease.

The end of the 19th and beginning of the 20th century is marked by the development and improvement of different open surgery methods (adenomectomies). For example, Bryant and Harrison [46] removed the prostate gland in a blind manner, Goodfellow [47], and then Proust and

Young [48,49] performed a complete midline perineal adenomectomy. S.P. Fedorov [50] and P. Freyer [6,51] performed and popularized the transvesical approach of adenomectomy, but there were also supporters of retropubic adenomectomy, who also successfully performed and developed the technique of V. Stolckum, A.T. Lidsky, T.Millin [52-54].

The discovery of X-rays at the end of the 19th century also gave a powerful impetus to the development of diagnostic and therapeutic methods in medicine and, in particular, urology, which led to the development of methods of urethrography, cystography, ureteropyelography and subsequently excretory urography, allowing visualization of the urinary tract of patients and determining the exact cause disturbances in the outflow of urine.

Thanks to the creation of endoscopic technologies with hemostatic instruments, the second half of the 20th century was marked by the rapid development of the use of minimally invasive endoscopic resection of prostate adenoma using transurethral access. Improvements in endoscopic resectoscopes and surgeon experience have led to a dramatic reduction in intraoperative and postoperative complications of BPH. The study of the causes of complications led to the development of indications and contraindications for various methods of removing prostate adenoma, based on the patient's age, size of the adenoma, detrusor condition, renal function, which in turn led to a significant improvement in the results of surgical treatment of patients with BPH and a decrease in postoperative mortality.

If until the middle of the 20th century, an established diagnosis of BPH was for many patients a sentence to surgical treatment methods, then with the development of fundamental sciences, urologists began to understand the mechanisms of hormonal regulation of the growth of prostate hyperplasia, the role of growth factors, apoptosis processes and the role of genetic and family factors in the cause of the development of prostate adenoma . The study of the mechanism of influence on prostate tissue and the role of testosterone led to the creation of drugs inhibitors of 5- α reductase; the study of the receptor apparatus of smooth muscle cells of the prostate stroma and lower urinary tract made it possible to safely use α -adrenergic blockers, and subsequently m-anticholinergics in the treatment of patients with disorders urination caused by BPH.

Thus, by the end of the 20th century, thanks to the improvement of laboratory research methods and the discovery of the PSA glycoprotein

(prostate-specific antigen), doctors began to better differentiate prostate adenoma from prostate cancer and approaches to the treatment of this patient population were improved. By the beginning of the 21st century, thanks to the development and improvement of diagnostic minimally invasive and non-invasive instrumental research methods, endoscopic technologies and the development of selective pharmacological agents, urologists began to achieve high results in the effectiveness of the treatment of BPH.

There are many treatments for LUTS associated with BPH. Although drug therapy, especially its combined form, is quite effective, up to 30% of patients require a more invasive approach - surgical methods for the treatment of prostate hyperplasia [55].

It should be noted that drug treatment is not always available, and refractoriness to drug treatment is possible. Therefore, in relation to these categories of patients, most specialists give preference to surgical methods of treating BPH, which continue to be the most effective methods for eliminating IVO and relieving LUTS.

Surgery for BPH is an optional treatment for patients with bothersome LUTS who do not wish to take medication, in cases where medications are ineffective, and in cases of severe LUTS [56].

There is a whole arsenal of surgical approaches to the treatment of LUTS/BPH. These include: TURP, transurethral incision of the prostate (TUIP), plasmakinetic resection of the prostate (PKRP, also known as bipolar TURP), plasmakinetic enucleation of the prostate (PKEP), open adenectomy (OAE), laparoscopic and robot-assisted adenectomy, transurethral microwave therapy (TUMT), transurethral needle ablation (TUNA) of the prostate, holmium laser enucleation (HoLEP) and resection (HoLRP) of the prostate, vaporization of the prostate with a 532 nm green laser ("Greenlight"), diode laser vaporization of the prostate, thulium laser enucleation (ThuLEP), prostatic stents, intraprostatic injections of ethanol and botulinum toxin type A, etc.

Many systematic reviews have summarized the growing evidence base supporting the use of these new methods. However, most reviews and meta-analyses focused only on International Prostate Symptom Score (IPSS), Quality of Life (QoL), maximum urinary flow rate (Qmax) and operative time [57–63].

1.3. Open prostate adenomectomy

Modern surgical operations to remove prostatic hyperplasia have been developed based on the centuries-old experience of “lithotomists” who have attempted to remove stones using the perineal approach. This explains the fact that perineal adenomectomy appeared several years earlier than suprapubic surgery. Sir William Fergusson in the 1830s was apparently the first to recognize the possibility of treating an enlarged prostate by removing prostate tissue obstructing the urethra. During one of the lithotomies using the perineal approach on an elderly man, he grabbed with forceps an area of some tissue between the stone and the bladder, and the stone was removed with this tissue. The patient subsequently found it much easier to urinate, and Fergusson was so satisfied with the result that he repeated the procedure whenever it was indicated, with satisfactory results. However, he did not propose this operation primarily for the treatment of an enlarged prostate, but only as an adjunct to lithotomy [64].

Since the end of the 19th century and for more than 100 years, the only option for surgical treatment of BPH has been open prostate adenomectomy (OPA). One of the earliest approaches to the prostate gland for performing adenomectomy was the so-called transsacral one. There was also a perineal approach, which was advocated by Young and Belt. The perineal approach is not widely used due to frequent postoperative urinary incontinence due to trauma to the external urethral sphincter, as well as the likelihood of damage to neighboring organs - the rectum, seminal vesicles [65,66].

Suprapubic or transvesical (transvesical) open adenomectomy was first performed in 1884 by Eugene Fuller. In 1895, he published data on 6 cases of “prostatectomy”, which were performed through a suprapubic approach, and drainage of the urinary tract was carried out transperineally [67]. The procedure was associated with a high mortality rate (18%) and did not gain acceptance until Peter Freyer performed his first prostatectomy at St. Peter's Hospital in London in 1900 [6]. The operation was a great success and became widespread. The mortality rate was 5%. In Russia, the first suprapubic adenomectomy was performed by S.P. Fedorov in 1908 [7]. In 1912, P. Freyer published data on the results of this operation in 1000 patients. It should be noted that he used the term “total enucleation of the prostate” in that period

and this intervention for more than 50 years was the “gold standard” for BPH surgical treatment [68,69].

Open transvesical adenomectomy (OTA) is the most common technique for performing OPA. Subsequent modifications of the technique were proposed by Harris (1934), Wilson Hay (1944), and in 1951 Hryntschak described transvesical adenomectomy with the principles and steps that are currently accepted in most urological centers [70].

A retropubic (retropubic) approach was developed later, in which the prostate adenoma was exposed by an incision in the anterior prostatic capsule. This method was first proposed by A.T. Lidsky in 1923 and then T. Millin in 1945 respectively [52,54]. Terence Millin, an Irishman by birth, played a key role in popularizing retropubic adenomectomy. Having moved to England, he became a member of the Royal College of Surgeons. On December 1, 1946, he published the landmark article “Retropubic Prostatectomy: A New Extravesical Technique” [69,70]. Millin's new operation was immediately recognized as an outstanding achievement in surgery and made a major contribution to reducing mortality in open adenomectomies. Millin adenomectomy quickly became widespread in the United States [69].

The advantages of retropubic adenomectomy are convenient anatomical access to the prostate, direct visualization of the adenoma during enucleation, precise separation of the urethra without damaging the sphincter, which reduces the risk of urinary incontinence, visualization of the adenoma bed and better opportunities for hemostasis, as well as minimal risk of bladder damage [70]. The disadvantages of this technique include the impossibility of a full examination of the bladder and the risk of damage to the pelvic venous plexus. Today it is possible to perform the so-called “minimally invasive adenomectomy,” which includes laparoscopic and robot-assisted modifications of retropubic adenomectomy.

One more of open surgery option for BPH is the so-called extraurethral transvesical and retropubic urethro- and vascular-sparing adenomectomy by Sergienko N.F. This surgery allows to preserve prostatic urethra as well as dorsal and urethral vascular plexuses [72].

Among the existing surgical approaches to the prostate gland - transvesical (Fyodorov S.P., 1908; Fuller A., 1895; Freyer P., 1901), retropubic (Lidsky A.T., 1923; Millin Th., 1945), perineal (Guthrie GY,

1834), ischiorectal (Voelcker F., 1911), transrectal (Sapozhnikov K.P., 1926) the suprapubic transvesical access has received the greatest recognition as the most direct and convenient, the retropubic access is used somewhat less frequently and the perineal one is very rarely used [73].

OPA is an effective and radical method for eliminating bladder outlet obstruction (IVO) caused by BPH. This open surgery represents the most invasive, but the most drastic (radical) method of BPH treatment. Positive outcomes of the procedure last for a long time. Open adenectomy decreases the severity of LUTS by 63-86%, an improvement in quality of life by 60-87%, an increase in Qmax by an average of 375% and a decrease in PVR by 86-98% [74,75,76]. The effectiveness of the operation was maintained over a follow-up period of up to 6 years [3].

However, this method has many disadvantages, the most dangerous of which is intense intraoperative bleeding, which is the result of mechanical separation of adenomatous tissue from the surgical capsule. The existing numerous options for final hemostasis during open adenectomy indicate the complexity of the problem and the absence of a single correct, effective and easy-to-perform method.

OPA is associated with a high rate of postoperative complications. In Europe occurrence of lethal outcomes is about 0.25%. Prevalence of postoperative complications, is 17.3% according to 2006 data [77] and remains within these limits until today. At the end of the 20th century, the percentage of complications varied between 12.5-23.02% [76,77,78,79]. Complications of OPA are distributed as follows: the need for hemotransfusion (7-27%); urinary incontinence ($\leq 10\%$); bladder neck sclerosis or urethral stricture (2-20%); wound infection 1-4.3%; urinary tract infection 6-8%; erectile dysfunction 3-5%; retrograde ejaculation is observed in 80-90% of patients; deep vein thrombosis, pulmonary embolism, myocardial infarction, stroke - less than 1%. The level of dissatisfaction with the operation was only 9% [69,74,75,76,80,81].

Despite a higher incidence of intraoperative bleeding, longer catheterization times and longer hospital stays, OPA is still used for 3% of prostatectomies in the USA [82], 14% in France [83], 12% in Sweden [84] and 40% in Israel [85].

Varkarakis I. et al. evaluated data from 232 patients who have undergone open transvesical adenomectomy for BPH within five years after surgery [80]. Improvements in IPSS scores, residual urine volume (RVV), and peak urine flow rate were statistically significant from 8 to 12 months after surgery and remained so at the final follow-up visit. The average hospital stay was 6 ± 0.9 days (from 4 to 10 days), the duration of stay of the urethral catheter was 5 ± 0.9 days (from 4 to 10 days). Long-term complications included bladder neck contracture (3.3%), which developed on average 10 months after surgery, urethral stricture (0.6%) and meatostenosis (1.3%). Reoperation was required in 3.9% of cases.

In a retrospective study by Adam C. et al. the results of surgical treatment of 201 patients were assessed [86]. There were significant differences in pre- and postoperative PVR (85 vs. 0.0 ml) and mean urinary flow rate (6.0 vs. 20.8 ml/s). The following postoperative complications were reported: persistent urinary incontinence (0.5%), endoscopic exploration due to bleeding (3%), open exploration (1%), urinary tract infection (13%) and wound healing by secondary intention (5.5%).

In the work of Oranusi C. et al. postoperative complications of transvesical adenomectomy in 362 patients were distributed according to the Clavien-Dindo classification. Documented complications were noted in 40.1% of patients. At the same time, the incidence of complications in grades I, Id, II, IIIa and IIIb were 0.8%, 0.6%, 35.1%, 0.6% and 3.0%, respectively. The greatest number of complications was observed in the early postoperative period - 34.5% of cases. Intraoperative complications were represented by bleeding (2.8%). Postoperative bleeding was observed in 18% of patients. All bleeding cases required multiple units of blood transfusion. The rate of late complications was 2.8%, the most common of which was urethral stricture - 1.4% [87].

A retrospective study by Arab scientists also applied the Clavien-Dindo classification to evaluate perioperative complications of transvesical prostate adenomectomy. The total number of complications was 42.3%. The average hospital stay after adenomectomy was 8.1 ± 1.8 days (from 5 to 15 days); the duration of stay of the urethral catheter was 7.9 ± 2.2 days (from 5 to 20 days). Mild complications (grades I and II according to Clavien-Dindo) accounted for 55.8%, and severe complications (grade III and higher according to Clavien-Dindo) accounted for 9.2% of the total number of patients. The rate of blood

transfusions was 24.5%, and repeat visits in the first 30 days after surgery were 1.2%. Mortality - 1.2%. Severe complications were significantly associated with a large volume of tissue removed [88].

Italian urologists Tubaro A. and de Nunzio C. [69] provide data on the total number of complications of transvesical adenomectomy in different centers, and this value varies from 13.6% to 46.5%. Consequently, research into alternative surgical treatments (for large prostates) with similar efficacy but minimal complications is ongoing.

Rigatti R. and Cestari A. believe that OPA can compete with transurethral endourological methods of surgical treatment of BPH by improving surgical technique, minimizing damage to the skin, and using modern hemostatic equipment to increase the efficiency and safety of open operations. Discussion and improvement of various modifications of open adenomectomy is a constant subject of discussion in the specialized medical literature [89].

1.4. Transurethral resection of the prostate

TURP is an endourological electrosurgical operation in which resection of hyperplastic tissue and coagulation of bleeding vessels is carried out using high-frequency current through a resectoscope.

At a time when open interventions for BPH were rapidly developing, transurethral techniques were developing also. In 1830, George James Guthrie, a young British Army surgeon, became the first to perform a dissection of the bladder neck with a hidden knife inserted through the urethra. Between 1839 and 1844, Mercier developed several instruments for transurethral removal of bladder neck obstructions, so-called “prostatotomes” [90]. He used them about 300 times and was satisfied with the method, but its use caused significant bleeding and most patients developed urinary incontinence. All of these tools and techniques were used blindly, caused severe bleeding, and were not particularly successful. However, they were the first of a long series of different instruments, their modifications and transformations, to be used in the early 1900s. be among the top invasive interventions for BPH [64].

High frequency cutting was first used by C. W. Collings of New York in 1926. In the same year, Maximilian Stern of New York invented a new instrument which he called the “resectoscope” [91]. Equipped

with a tungsten wire loop that could be moved by a rack back and forth using a handle on the outside, the prostate tissue could be cut at the right angle of view by moving the loop. This resectoscope was an excellent cutting instrument, but it lacked coagulation capabilities and would have been abandoned if not for the persistence and electrical engineering expertise of T.M. Davis. He developed a switch that could use two currents: one continuous for cutting and one damped for coagulation. He also increased the size of the loop and window to allow larger pieces of tissue to be removed. The excellent results reported by Davis in 1931 revived TURP.

Inspired by Davis, Joseph F. McCarthy greatly improved the resectoscope. In 1932, he developed a lens system that expanded the field of view, used a non-conductive bakelite shell and separate currents for coagulation and cutting. Most importantly, he moved the wire loop and cutting window to the tip of the tool. The Stern-McCarthy resectoscope, after it became known, was the first practical resectoscope with a cutting loop [64,92].

The paradigm in the surgical treatment of BPH shifted from OPA towards minimally invasive TURP in the 70s and early 80s of the 20th century. Initially, this technique involved electrosurgical resection of adenomatous tissue of prostatic hyperplasia using a monopolar electrode [74]. For more than half a century, TURP was considered the “gold standard” of the BPH operative treatment.

TURP is characterized by significant improvement in the IPSS score as well as the patient's quality of life (QoL) score. After TURP, Qmax and other urodynamic parameters significantly improve [93]. In a systematic review and meta-analysis of 20 randomized controlled trials (RCT) with a maximum follow-up of 5 years, TURP was significantly associated with improvement of Qmax (+162%), reduced IPSS (-70%), QoL (-69%) and PVR (-77%) [59]. However, TURP can be accompanied by various complications. Complications rate and their severity directly depends on the volume of the prostate gland. The most dangerous of TURP complications are bleeding and TUR-syndrome. [62].

The essence of TURP is layer-by-layer removal of the mucous membrane, muscle layers of the urethra, and then hyperplastic prostate tissue with vessels passing through it. Damage to blood vessels during resection of prostate adenoma is accompanied by bleeding of varying

severity. The same vessel can be damaged several times - at different levels and in different planes. The degree of bleeding depends on the number of damaged vessels, the type of vessels (arterial, venous) and their caliber, as well as the presence of arterial hypertension and the state of the blood coagulation system.

There are the following TURP options:

“pseudo-TURP”: consists of creating a “urinary track” by resection of only a small amount of hyperplastic tissue, mainly in the area of the bladder neck, or partial resection of part of the middle lobe of the prostate;

“portional TURP”: from one third to 80% of the adenoma tissue is removed, forming a cone-shaped cavity in the prostate gland. Portional resection is divided into palliative and subtotal transurethral resection of the prostate gland;

“total TURP” (transurethral prostatectomy): hyperplastic tissue is almost completely removed, and therefore this option can be equated to open surgery;

“radical TURP”: removal of the entire prostate gland. This method is used to treat the initial stages of prostate cancer [94].

One of the serious complications of monopolar TURP (mTURP) is TUR syndrome - water intoxication syndrome. The pathogenesis of TUR syndrome is based on the opening of venous vessels, into the lumen of which a large amount of irrigation fluid moves. Further circulation of fluid in the bloodstream leads to the development of hypervolemia and hyponatremia. Hyponatremic shock can lead to acute renal failure. TUR syndrome is caused by a long resection time, which contributes to the occurrence of electrolyte disorders. This, in turn, limits the possibility of performing mTURP in patients with a prostate volume of more than 80 cm³ [95,96].

The liquid used for mTURP should in order to avoid charge dissipation. Not electrically conductive liquids (glycine, glucose, sterile water) are hypotonic. Resection of tissue leads to the opening of the lumen of the vessels and the absorption of irrigation fluid through these vessels at a rate of about 30 ml/min. During an operation lasting about 1 hour, the total volume of absorbed hypotonic fluid can be about 2 liters, which leads to dilution hyponatremia and the development of TUR syndrome of varying severity. Monopolar TURP (hereinafter referred to as mTURP) is currently the standard treatment for BPH with a gland

volume of 30-80 cm³. However, with sufficiently extensive experience of the urologist, this method is also applicable for glands of larger volume - 100-120 cm³, but is practically impossible for adenomas of 150 cm³ or more due to the high risk of complications [97].

The introduction of bipolar TURP technology made it possible to avoid such limitations. Unlike mTURP, in bipolar TURP (bTURP) systems, electrical energy does not pass through the patient's body to reach the return electrode. The bipolar circuit is closed locally, i.e. energy is limited to the resection site between the two poles on the resection loop (a "true" bipolar system) or between the active (resection loop) and passive electrode located on a specially designed resectoscope sheath (a "quasi" bipolar system). bTURP, compared to mTURP, requires less energy and voltage to complete the circuit [98]. In this case, energy is transferred from the active electrode to the surrounding conducting solution. The liquid evaporates to form a gas layer - plasma - surrounding the loop, which resists the flow of energy.

Five systematic reviews and meta-analyses comparing mTURP with bTURP found no differences in effectiveness between the techniques [59, 95-102]. However, when comparing safety parameters, bTURP was superior. The safety profile included shorter hospital stay, lower risk of blood transfusion, clot obstruction, and lower rates of TUR syndrome. A Cochrane review of 59 randomized controlled trials involving 8924 patients comparing mTURP with bTURP confirmed these findings [103]. An obvious disadvantage of mTURP is the risk of developing such a serious complication as TUR syndrome. There was no clinically significant difference between the 2 techniques in terms of sexual function and satisfaction. That is, bipolar resection is equivalent to monopolar in terms of effectiveness criteria, but is much superior in terms of safety criteria. One way or another, specialists must draw conclusions and the choice of method remains with the urologist [104].

In a systematic review, Rassweiler J. et al. [105] analyzed the incidence of complications of TURP according to 3 consecutive periods (I period: 1979-1994; II - 1995-2000 and III - 2000-2005). The authors noted that over time, due to improvement of the TURP technological and instrumental support, necessity for hemotransfusions decreased to 0.4% (previously 7.1%), incidence of TUR-syndrome tends to 0 (previously 1.1%), obstruction by blood clots is 2% (previously 5%), urinary tract infection (UTI) is 1.7% (previously 8.2%). Urinary

retention (3% versus the previous 9%) is associated primarily with primary detrusor insufficiency rather than with incomplete resection, which most often characterized incorrectly chosen tactics of surgical treatment. Early urge incontinence occurs in approximately 30-40% of patients. Long-term complications of TURP include urethral stricture (2.2-9.8%), urinary bladder neck sclerosis (0.3-9.2%). The rate of re-intervention varies between 3-14.5% after 5 years after surgery. Mortality after TURP is 0.0-0.025%.

Data presented by Marszalek M. et al. with regard to intraoperative, perioperative and postoperative complications, TURP generally corresponds to those presented above, while the authors additionally note that long-term iatrogenic stress urinary incontinence occurs in less than 0.5% of cases, retrograde ejaculation is observed in more than 90% of cases, but there is controversy whether it should be classified as a complication or consequence of TURP [109].

In a systematic review and meta-analysis by Cornu J.-N. et al. [59], dedicated to the functional results and complications of transurethral interventions for LUTS caused by BPH, along with others, carried out a comparative analysis of the effectiveness of bipolar (bTURP) and monopolar TURP (mTURP) for a number of indicators. According to meta-analysis after 12 months. After surgery, there was no significant difference between bTURP and mTURP in IPSS scores, quality of life indicators, TMR and prostate volume. However, bTURP procedures appear to be associated with a higher Qmax.

Data on long-term outcomes of TURP were very sparse and only three studies were available for meta-analysis [110,111,112]. There was a trend towards a significantly greater reduction in IPSS after mTURP, but there were no significant differences in objective parameters (PVR and Qmax). However, due to heterogeneity of data, high dropout rates, and varying follow-up lengths among these studies, these results should be interpreted with caution. More reliable data with long-term follow-up are needed.

Regarding early and late postoperative complications, at 12-month follow-up, the incidence of urethral strictures, bladder neck contractures, and urinary incontinence (defined in most studies as postoperative stress urinary incontinence) was similar after mTURP and bTURP. The overall reoperation rate at 1 year was low and did not differ significantly between groups. Only four studies provided data on complications from

2 to 5 years after surgery. There were no differences between groups in the incidence of urethral strictures, bladder neck contractures, or reoperation rates.

Table 1.
Use of the Clavien-Dindo classification system in the assessment of postoperative complications of TURP.

Degree of complication	Complication rate				Mbaeri T.U. (n=97) n (%)
	Stroman L. (n=66) n (%)	Mamoulakis C. (n=198) n (%)	Sagen E. (n=354) n (%)		
			Complications in hospital	Complications within 3 months p/o	
I degree	4 (6)	26 (59.1)	63 (18)	40 (11)	6 (20.7)
II degree	3 (4.5)	13 (29.5)	36 (10)	45 (13)	16 (55.2)
IIIa degree			4 (1.1)	5 (1.4)	6 (20.7)
IIIb degree	1 (1.5)	1 (2.3)	3 (0.8)	4 (1.1)	
IVa degree		2 (4.5)	2 (0.6)	2 (0.6)	
IVb degree		1 (2.3)	0	0	1 (3.4)
V degree		1 (2.3)	0	1 (0.3)	
Total	8 complications in 6 patients (9.1%)	44 complications in 31 patients (15.7%)	100 complications in 89 patients (20%)	97 complications in 90 patients (25%)	29 complications in 24 patients (24.74)

In 2010 Mamoulakis C. et al. [110], in 2014 Stroman L. et al. [111], in 2019 Sagen E. et al. [112], and in 2020 - Mbaeri T.U. et al. [113] reported their experience of using Clavien-Dindo classification system of surgical complications in assessment of postoperative complications of TURP (Table 1).

In general, TURP is the standard treatment for prostate volumes of 30-80 cm³ and moderate/severe LUTS [3]. Although the EAU has established a cut-off value of 80 ml for large adenomas, in a recent meta-analysis comparing mTURP and bTURP in medium- to large-sized prostatic hyperplasia, the mean gland volume was 108.46 g or 98.04 ml [114]. TURP is also performed if there is severe concomitant pathology that does not allow open adenectomy, as well as in patients under 60 years of age with preserved sexual function.

1.5. Methods of endoscopic enucleation of prostatic hyperplasia

Despite the attractiveness of TURP in terms of efficacy and safety when compared with OPA, resection does not have the radicality of open intervention. In this regard, the idea of creating endoscopic enucleation methods that would neutralize the disadvantages of both TURP and OPA began to take shape. The concept of endoscopic enucleation of the prostate (EEP) was first announced in the EAU Guidelines in 2016. This category of transurethral endourological interventions unites all currently available modalities of prostate enucleation [115].

Various types of energy can be applied to perform EEP. Among the methods of electrosurgical enucleation, bipolar enucleation of the prostate is the most common, but monopolar enucleation also exists.

There is a wide range of methods of laser enucleation of prostate hyperplasia: Holmium Laser Enucleation of the Prostate, Thulium Laser Enucleation of the Prostate, GreenLight Laser Enucleation of the Prostate (GreenLEP), diode laser enucleation of the prostate (DiLEP) and others.

1.5.1. Methods of electrosurgical enucleation of prostatic hyperplasia

1.5.1.1. Monopolar enucleation of the prostate (MEP).

The founder of monopolar enucleation of the prostate (MEP) was Y. Hiraoka [116]. For mechanical separation of prostatic hyperplasia tissue from the capsule, he used a special blade with a blunt end (the so-called "Hiraoka knife") or performed separation with the tip of a resectoscope. Among 300 patients who have undergone MEP, there was not a single case of re-intervention due to recurrence of prostatic adenoma.

A group of russian researchers compared the results of MEP with monopolar TURP. Both surgical treatment methods demonstrated similar efficacy in eliminating infravesical obstruction caused by ИЗР. The MEP procedure combined the advantages of EEP with the availability of monopolar TURP [117]. Methods of holmium and thulium laser enucleation of the prostate have shorter learning curves compared to MEP [118].

1.5.1.2. Bipolar (plasmakinetic) enucleation of the prostate (BipEP).

Bipolar enucleation of the prostate (BEEP) combines a whole range of procedures:

- plasmakinetic enucleation of the prostate (PkEP),
- transurethral resection-enucleation of the prostate (TUERP),
- bipolar plasma enucleation of the prostate (BPEP),
- transurethral vapo-enucleation-resection of the prostate (TVERP).

All of them differ from each other in equipment, types of electrodes, and power settings used to carry out enucleation and hemostasis [10,119].

In the matched-pair analysis by Magistro G. (2021) comparing TURP, HoLEP and bipolar transurethral enucleation of the prostate (Bipolar TUEP) in medium-sized prostates both enucleation techniques were superior in terms of efficacy to TURP. Both resection and enucleation are efficient and safe procedures in patients with medium-sized prostates (50 cm³), but irrespective of the technical approach, transurethral enucleation is superior to TURP in terms of perioperative and functional outcomes. Tissue retrieval percentage in Bipolar TUEP and TURP was 70% vs. 50% respectively, improvement of LUTS (change IPSS) was -14 vs. -10, urodynamic parameters (Q_{max}: +19 ml/s vs. +12 ml/s; PVR: -95 ml vs. -80 ml. All techniques showed an equally low complication rate (6.9% vs. 10.3%) [120].

In a review by Ryang S.H. et al. [121] a comparative analysis of data from 5 authors who performed bipolar enucleation in 564 patients. Moreover, regardless of the technology and equipment used, all authors present comparable results.

Abdulwahab Al-Radhi M. et al. (2021) in a prospective comparative study analyze the efficacy and safety between bipolar transurethral enucleation of the prostate (BipoLEP) and bipolar transurethral resection of the prostate (B-TURP). There were significant improvements in 3-month postoperative parameters, including: post void residual urine, maximum flow rate, IPSS and QoL in each group. However, there were no significant differences of preoperative and 3-month postoperative parameters, including: post void residual urine, maximum flow rate, IPSS and QoL between these 2 groups. BipoLEP can produce a more radical prostatic hyperplasia removal with better

safety profile and faster postoperative recovery. It may become a more favorable surgical alternative to the B-TURP, especially for the prostate larger than 80 g [122].

1.5.2. Methods of laser enucleation of prostatic hyperplasia

1.5.2.1. Holmium laser enucleation of the prostate (HoLEP).

A major event in BPH surgery was the emergence of a fundamentally new technique of holmium laser enucleation of the prostate (HoLEP). The use of laser energy ensures both tissue destruction and separation, as well as high-quality hemostasis. Transurethral morcellation of enucleated tissue allows for the removal of hyperplastic tissue in large volumes. All this ensures high efficiency and minimally invasiveness of the technique.

The origin of HoLEP lie in the solid-state laser Holmium:YAG (Ho:YAG - holmium-yttrium aluminum garnet laser) with a wavelength of 2100 nm. This laser is used in the treatment of urolithiasis (laser lithotripsy), for dissection of urethral and ureteral strictures, ablation of small tumors, etc. The holmium laser is a pulsed laser and penetrates tissue to a depth of 400 μm [123,124]. The chromophore of the holmium laser is water. The pulsed action of the laser leads to the formation of water vapor bubbles, which exist for a very short time and have a thermomechanical effect. Due to this effect, tissue ruptures (separates) and evaporates. The holmium laser also has coagulation properties. To achieve a coagulating effect, the energy of laser radiation must be reduced, for which the laser fiber is removed from the tissue by 1-2 mm. A cauterization effect occurs with steam - the tissue turns white. In this way, surface coagulation of the tissue is carried out without carbonization. Due to its high water absorption, this laser requires direct contact with the tissue, in contrast to the neodymium Nd:YAG laser, which is non-contact [10,125,126].

Another laser effect is thermomechanical dislocation, when a resectoscope with a laser fiber is placed in the space between the hyperplasia and the adenoma capsule, a shock wave generated by water vapor bubbles contributes to the completion of enucleation, while simultaneously providing a coagulating effect [126].

Before the development of HoLEP, Ho:YAG laser was used together with the Nd:YAG laser to vaporize and coagulate the hyperplastic tissue. This combination of holmium and neodymium lasers was called CELAP - combined endoscopic laser ablation of the prostate [127]. Subsequently, the holmium laser was used separately in holmium laser ablation of the prostate (HoLAP) [124].

The first HoLEP was performed by New Zealand urologists P. Gillig and M. Fraundorfer. In 1998, they presented first results of the new technique, performed on 14 patients [128,129]. A major role in the widespread use of HoLEP was played by the development of equipment for transurethral intravesical destruction and evacuation of hyperplastic prostate tissue after enucleation. A morcellator was created for these purposes.

Equipment for HoLEP. Laser energy is delivered via reusable end-emitting quartz fiber. Classic holmium enucleation uses a 26 Fr continuous irrigation resectoscope with a fixed inner sheath with a metal tip, as well as a modified laser bridge. The laser fiber was passed through a 7 Fr stabilizing catheter. Kuntz introduced a modified working element with a channel for the laser fiber, which allows holding and stabilizing the fiber during enucleation [123].

The energy of a holmium laser with a power of up to 120 W allows dissecting the prostate hyperplasia tissue and separating it from the surgical capsule. In the era of open BPH surgery, separation of the prostate hyperplasia tissue was performed mechanically - with the surgeon's finger [73].

The first proposed enucleation technique was the three-lobe method. First, the middle lobe (if present) was enucleated, then the lateral lobes were successively enucleated, which were morcellated in the bladder cavity. In the absence of a morcellator, the enucleated prostate hyperplasia tissue is resected and evacuated through a resectoscope (the "mushroom" method). Along with enucleation, coagulation of bleeding vessels is performed as needed. For this, the tip of the laser fiber is removed from the vessel by 3-4 mm [128].

In 2010, two groups of scientists proposed a modification of the classical HoLEP technique and the two-lobe technique [130,131]. The latest modification of the HoLEP technique involved enucleation of the adenoma en bloc, the en-block technique [123,132].

Historically, TURP has been the surgical option to which all other surgical interventions for BPH are compared. It is the “gold standard” for the treatment of BPH. However, there is a trend of paradigm shift in favor of HoLEP. HoLEP is one of the most popular surgical treatment options for BPH. This technique is especially relevant for large-volume hyperplasia, although it is no less effective for small adenomas [133-136].

HoLEP should be recommended to patients with a prostate volume of more than 80 cm³, along with simple prostatectomy and bipolar enucleation of the prostate. The advantages of HoLEP over TURP, such as a lower number of postoperative complications, low recurrence rate and encouraging long-term results, make it the new "gold standard" of surgical treatment of prostatic hyperplasia [3,135-137].

HoLEP is the most studied laser procedure today, with the largest number of RCTs assessing its effectiveness in comparison with TURP, OPA, bipolar enucleation and other laser techniques [138]. The study by Gild P. et al. (2023) provides data on 11 years of HoLEP experience. This study included 774 patients, the median follow-up time after the intervention was 52 months (interquartile range (IQR) 32-77)), the overall median prostate-specific antigen was 0.91 mg/dL (IQR 0.5-1.8), the median IPSS and QoL were 3 (IQR 1-7) and 1 (IQR 0-2), respectively. Drug treatment for LUTS occurred in 20 patients (2.6%), 15 (2%) patients required reoperation and persistent urinary incontinence occurred in 17 (2.2%) patients [139].

Multiple randomized trials have shown that HoLEP in the postoperative period results in a reduction of catheterization and hospitalization time [140,141].

In meta-analysis comparing laser enucleation of the prostate with laser vaporization, bipolar transurethral resection of the prostate, only HoLEP was resulted in a statistically significant improvement of IPSS and Qmax. After HoLEP, there was no need for blood transfusions, in TURP the frequency of blood transfusions was 2.2%. The recurrence rate after HoLEP was 4.3%, after TURP - 8.8%. The duration of catheterization and hospitalization was also lower after HoLEP. Only the duration of the intervention was higher with HoLEP compared to TURP [58].

It is important to compare HoLEP with the most effective and radical option for surgical treatment of BPH - OPA. In two meta-

analyses comparing HoLEP and bipolar enucleation with OPA, it was demonstrated that there was no significant difference between EEP and OPA in the medium-term and long-term follow-up. Moreover, endoscopic enucleation methods were characterized by a shorter period of irrigation, catheterization and hospitalization [76,142].

In a meta-analysis by Jones P. et al. [12], comparing 3 randomized trials comparing HoLEP and OPA for large adenomas, showed that these operations do not have significant differences in the dynamics of IPSS, QoL, Qmax and PVR 12 and 24 months after surgery. Open surgery is associated with statistically significantly better indicators of the duration of surgical intervention and the volume of pancreatic tissue removed, and HoLEP is associated with the volume of blood loss, time of bladder catheterization and length of stay of the patient in the hospital. At the same time, in terms of the frequency of complications, these surgical treatment options do not have significant differences among themselves, with the exception of the frequency of blood transfusion; there was one death in the OPA group.

Ahyai S.A. et al. [143] compared resection rates for TURP, HoLEP, and OPA and made interesting conclusions. Moreover, the patients were grouped as follows: group 1 included 99 identical pairs of holmium enucleation-transurethral resection, group 2 - 53 identical pairs of holmium enucleation-open prostate adenomectomy. The speed of resection and the duration of the holmium enucleation operation were statistically significantly faster than for resection (0.61 versus 0.51 g/min and 62 versus 73 min) and practically did not differ from those for OPA (0.92 versus 1.0 g/min). min and 101 vs 90 min). That is, the question of which of the three procedures is faster can be answered: HoLEP is faster than TURP and approximately as fast as OPA.

In a study by Cai F. et al. [144] assessed the complication rates of 3 endoscopic procedures in 625 patients: TURP (214 patients), plasmakinetic resection of the prostate (PKRP) (207 patients), and HoLEP (204 patients) according to the Clavien-Dindo system. TURP was associated with a higher overall complication rate compared with PCRP and HoLEP. The incidence of Clavien-Dindo grade II complications was significantly higher in patients undergoing TURP compared with PCRP and HoLEP, and the number of grade III and IV complications was significantly higher in the TURP group compared with HoLEP. According to the authors, PCR and HoLEP are associated

with fewer complications and a better safety profile, and the system can be used for standardized assessment of emerging complications, but requires Clavien-Dindo further modification for better application.

In a recent review by Taratkin M. et al. [145] the Clavien-Dindo system was used to compare the safety of prostate vaporization (PV) and EEP techniques. Both techniques use lasers and the EAU recommends them for similar patient groups. The duration of the operation was shorter in the VP group. IPSS and Qmax values at 12 months were worse in the VP group, while quality of life was not significantly different. After VP there were fewer complications of Clavien-Dindo grades I and II, especially complications such as the need for blood transfusion and transient urinary incontinence. The incidence of complications of grade IIIa and higher was the same (3-6%). The reoperation rate was assessed in only one study and was significantly higher in the photoselective vaporization of the prostate (PVP) group at 60 months of follow-up, 2.7% versus 0%.

HoLEP is a safe and valuable alternative to TURP and OPA. Global costs of HoLEP are comparable to those of TURP. HoLEP has proven to be a strong competitor to OPA due to consistent reduction in indirect costs, mainly due to shorter hospital stay, resulting in significant cost savings due to lower global costs. However, further studies that include the cost of laser equipment as well as multicenter experience are needed to evaluate the economic benefits of laser enucleation of the prostate compared with standard surgical approaches [146].

The most common intraoperative complication is bleeding (5.2%), damage to the bladder wall (5.5%); Early postoperative complications include fever (1.3%), bladder tamponade (2.3%), acute urinary retention (11.8%); long-term complications are urinary incontinence (12.6%), urethral stricture (2.9%). Inflammation in the prostate and inadequate hemostasis are the main causes of bleeding [147].

HoLEP has high clinical effectiveness in the treatment of patients with prostatic hyperplasia. According to Dymov A.M. [148] the total index of complaints on the IPSS scale decreased on average from 21.3 ± 4.1 to 5.6 ± 1.8 points, the quality of life (QoL) index from 4.1 ± 1.1 to 1.9 ± 0.5 points ($p < 0.05$). The volume of the prostate gland decreased on average from $62.8 \pm 19.3 \text{ cm}^3$ to $20.2 \pm 8.3 \text{ cm}^3$. The maximum urinary flow rate (Qmax) increased on average from 8.0 ± 2.2 to $21.5 \pm 3.9 \text{ ml/sec}$ ($p < 0.05$). The volume of residual urine decreased from 49.3 ± 45.1 to

15.4±4.4 ml (p<0.05). The following complications of holmium enucleation of prostate hyperplasia were identified: bleeding (3.5%), short-term urinary incontinence, which resolved within a month (3.5%), meatostenosis (3.5%). Holmium enucleation demonstrated better clinical efficacy in eliminating bladder outlet obstruction compared with transurethral electroresection of prostate hyperplasia with fewer complications. Unlike TUR, holmium enucleation can be used for hyperplasia of any size, as well as in patients with a complicated somatic background (high risk of bleeding). Holmium enucleation is accompanied by less blood loss (8.6±1.9 vs 17.5±2.4 g/l, p<0.05).

Studies have shown that the use of EEP techniques for large and giant BPH can significantly reduce the frequency of PA use, which significantly increases the efficiency of the hospital. When removing BPH ≤ 80 cm³ EEP and TURP techniques are comparable in their effectiveness in eliminating IVO and in reducing the severity of LUTS. When removing BPH ≤ 80 cm³ EEP techniques differ from TURP in the longer duration of the operation (56.4±14.4 and 46.4±8.5 minutes, respectively), less blood loss, and more radical removal of the prostate gland (prostate volume decreased by 73.0 and 63.6%, respectively) while PSA is reduced to 0.8 and 1.4 ng/ml, respectively, with more efficient use of bed capacity (reducing the duration of catheterization and hospitalization) [149].

1.7. Clavien-Dindo classification system in assessing of postoperative complications of surgical treatment of BPH

Analysis of literature data suggests that in the treatment of LUTS caused by BPH, minimally invasive technologies demonstrate results comparable to traditional open operations and even surpass them in terms of blood loss, hospitalization time and urethral catheter placement. For this reason, ideas arise about the futility of using open interventions. However, the high cost of equipment and consumables, a long learning curve and the lack of a sufficient number of randomized studies to study long-term treatment outcomes do not yet allow these techniques to be considered as generally accepted and standard options for the treatment of BPH, at least not in every urological center [58,75,76,118,136,143].

Everything new is well forgotten old. Radicality, which is the key to the success of surgical treatment of BPH, lies in the “anatomical

enucleation” of the adenoma within its surgical capsule. And if with OPA, which gives the best results, enucleation is carried out manually, blindly, then with endoscopic enucleation and, in particular, with laser enucleation of the prostate, this procedure is performed under visual control, with the most complete hemostasis [30].

It is also important to consider that any surgical intervention must be effective, safe, anatomical and not accompanied by gross cosmetic changes. OPA and TURP do not solve all the problems: open adenectomy is accompanied by a large number of intra- and postoperative complications, TURP is devoid of anatomy, since it does not allow the removal of hyperplastic tissue completely, within the capsule. Accordingly, there is a risk of relapse (after TURP up to 15%) [59,105]. HoLEP, in turn, is characterized by a longer operative time and a high incidence of postoperative urinary incontinence, which varies from 8.5% to 42.7% according to different authors [150].

The authors conduct analyses of BPH surgical treatment results, including comparative analyses of various methods, unsystematically, often only by listing the complications that have arisen. There is no unified approach to assessing surgical complications associated specifically with BPH surgery. There are no adequate criteria for the standard ("normal") course of the postoperative period, as well as criteria for postoperative complications that would allow a standardised approach to assessing each method of BPH surgery [151-153].

In this regard, to assess the effectiveness of any surgical intervention, the most important role is played by taking into account the complications that arise. This issue can be resolved with a valid and reliable classification system for surgical complications. A successful attempt to standardize complications associated with surgical interventions is the classification system proposed by Clavien P.A. [154] (1992), which was originally used to evaluate complications associated with cholecystectomy.

Mitropoulos D. et al. [155] performed a systematic review of 204 articles that reported the use of the Clavien-Dindo classification for the assessment of urological complications. The authors note the incorrect use of this classification in 35.5% of articles - those cases where modifications are indicated, without assigning degrees to complications and indicating intraoperative complications as causes. Mitropoulos D. et

al. rated the Clavien-Dindo classification as “strongly recommended” for the assessment of urological complications.

The essence of the classification of Clavien P.A. [154] (1992) and the modified classification of Dindo D. [21] (2004) is to assess not only the frequency, but also to grade postoperative complications according to their severity. Such tactics make it possible not only to register most complications, but also prevent underestimation of negative results of the intervention.

With this approach, it is important to first of all highlight life-threatening complications associated with high mortality, requiring the patient to stay in the intensive care unit with high consumption of medical resources and separate them from "mild" complications.

On this basis, the modified classification of Clavien P.A. and Dindo D. (2004) allows to evaluate complications by the degree of invasiveness based mainly on medical aspects, and, above all, taking into account the invasiveness of the treatment carried out to correct complications.

In urology, an adapted Clavien-Dindo classification system has been used to assess postoperative complications of radical retropubic, laparoscopic and robot-assisted prostatectomies [156-158], radical cystectomies [159], and renal surgery [160]. The use of this classification to systematize complications of various surgical methods for treating BPH is presented above.

Surgical practice has shown that there is no ideal classification of complications, but among the existing ones, the most optimal was the Clavien-Dindo classification of postoperative complications (2004), the main disadvantage of which was the lack of a clear boundary between normal postoperative course and complicated one [21]. For this reason, deviations in the assessment of the frequency and severity of complications are possible among different centers.

In Uzbekistan such criteria in accordance with the Clavien-Dindo classification were developed for complications of endoscopic surgery for nephrolithiasis. According to the authors, the correct distribution of complications not only by frequency but also by severity, taking into account additional interventions to eliminate them, the localisation of the stone in the urinary tract and its size (category of complexity from the standpoint of endoscopic intervention) plays a huge role in an objective assessment of the quality of the intervention. Monitoring complications

allows to evaluate the results of patient treatment in a separate clinic, center, the quality of work of surgeons of different qualifications. Thanks to the analysis of complications not only by frequency but also by their severity, it is possible to create a prerequisite for the development of preventive and tactical measures to prevent them and an algorithm for managing complicated patients. Ultimately, this will improve the quality of surgical interventions. An adapted classification of complications of endoscopic treatment of urolithiasis taking into account the complexity of stones would be useful in developing standard information protocols for patients about the nature of the upcoming operation, possible complications and the course of the postoperative period [26,161,162].

Comparative analysis of the results of surgical treatment methods of BPH by various authors is not without certain drawbacks. Lack of systematic approach to assessing intra- and postoperative complications, mechanistic listing of complications had brought to necessity to study nature of postoperative complications of surgical treatment of BPH, their classification and comparative analysis in relation to definite method of surgical treatment, as well as the development of measures to eliminate complications is beginning to acquire increasing importance [151-153].

A convenient tool for this purpose is the modified Clavien-Dindo classification system [21]. Until recently, there were no adequate criteria by which each method of surgical treatment of BPH could be assessed even at the development stage.

In 2022, similar criteria were developed by authors to assess the results of various methods of surgical treatment of BPH. We believe that the criteria for the normal (uncomplicated) postoperative course in surgical treatment of BPH, as well as the criteria for postoperative complications, developed by the teams of the Republican Specialized Scientific and Practical Medical Center of Urology (Tashkent) and the Department of Urology of the Samarkand State Medical University, are an important step in unifying the assessment of complications of surgical methods for the treatment of BPH. It should be emphasized that the developed criteria are universal for assessing both traditional open and minimally invasive interventions undertaken for BPH, which allows for an objective assessment of the quality of surgical intervention and the identification of the shortcomings of a particular method of surgical treatment [163,164,165,166].

In this aspect, the use of the modified Clavien-Dindo classification of surgical complications may be promising. A standardized classification of complications will allow for a correct comparison of surgical results between different medical institutions, as well as within the same medical institution over time, or among operators. In addition, it allows for a better assessment of the influence of various risk factors on the outcome of the procedure.

Predicting the course and outcomes of surgical complications during open adenectomy of the prostate in the perioperative period is a complex task, the solution of which requires special studies, among which the use of a unified, standardized classification and rubric plays a special role.

CHAPTER II. CLINICAL MATERIAL AND RESEARCH METHODS

2.1. General characteristics of clinical material

The results of examination and treatment of 150 patients with benign prostatic hyperplasia were retrospectively and prospectively studied.

Depending on the method of surgical treatment that patient had undergone, three groups of patients were separated. The first group included 60 (40%) patients who have undergone open (traditional) prostate adenectomy (OPA) with hemostasis by tamponing the bed of the removed prostate adenoma. The second group included 50 (33%) patients who have undergone transurethral bipolar electroresection of the prostate gland. In the third group 40 (27%) patients who have undergone holmium laser enucleation of the prostate (HoLEP) were included.

Surgical treatment of BPH in patients of the first and second groups was performed in the Samarkand branch of the Republican Scientific Center for Emergency Medical Care. First group patients were operated during 2011-2019 period, the second – in 2018-2020 and the third group patients were operated at the Republican Specialized Scientific and Practical Medical Center of Urology (RSSPMCU) during 2018.

All patients were subjected to a comprehensive physical, laboratory and instrumental examination, including urodynamic examination, which was carried out before surgery, as well as at 1, 3 and 6 months after surgery.

Examination of patients included the collection of complaints, anamnesis of the disease and life, an objective examination with a mandatory digital rectal examination of the prostate gland, a general blood test, a biochemical blood test (the level of creatinine, urea, residual nitrogen, glucose was determined), determination of the levels of total PSA (prostate-specific antigen) blood serum, general urine analysis, examination of prostate secretions, as well as bacteriological examination of urine in the presence of bacteriuria.

An instrumental examination of the patient involved performing an ultrasound (US) examination of the kidneys, bladder and prostate gland. An ultrasound scan of the kidneys examined the thickness of the renal

parenchyma, its structure, the size of the cavity system and determined the presence of cystic and space-occupying formations, as well as stones. The lower urinary tract and prostate gland were examined with transabdominal and transrectal probes. At the same time, the size and echostructure of the prostate gland were assessed. Transabdominal ultrasound scanning determined the presence and size of the middle lobe of prostatic hyperplasia and the volume of residual urine.

In addition to the listed mandatory methods, in some groups of patients additional diagnostic methods were performed, such as plain and intravenous excretory urography or multislice computed tomography without and with contrast for individual indications.

In order to determine the rate of urination, in particular the maximum rate of urination (Q_{max}), all patients underwent uroflowmetry.

Uroflowmetry was performed in all patients, except for patients with a previously installed urethral catheter or cystostomy. In the presence of drainages, cystometry and artificial uroflowmetry (urination through cystostomy drainage) were performed to determine the functional state of the detrusor in order to predict the degree of restoration of adequate independent urination in the postoperative period.

An objective assessment of the severity of LUTS and the quality of life of patients was carried out by patients filling out the International Prostate Symptom Score (IPSS) questionnaire, as well as answering a question to assess the quality of life (QoL). For this purpose, the I-PSS questionnaire adapted for the Republic of Uzbekistan in Uzbek language was also used [167].

In accordance with the rules for filling out the IPSS questionnaire, a patient should answer to 7 questions, than calculation of the total IPSS score allows the patient to be included in one or another group depending on the severity of the clinical symptoms of the disease: mild (1-7 points), moderate (8-19 points) and severe symptoms (20-35 points). After assessing LUTS, the patient answered a question that assessed the patient's quality of life depending on his attitude to the urinary disorders that were present upon admission.

When examining patients, attention was specifically focused on the presence of concomitant urological diseases, as well as previous urological interventions on the urinary tract and genital organs. If

concomitant urological pathology was detected, additional research methods were performed (W-ray methods, computed tomography, urethrocytoscopy).

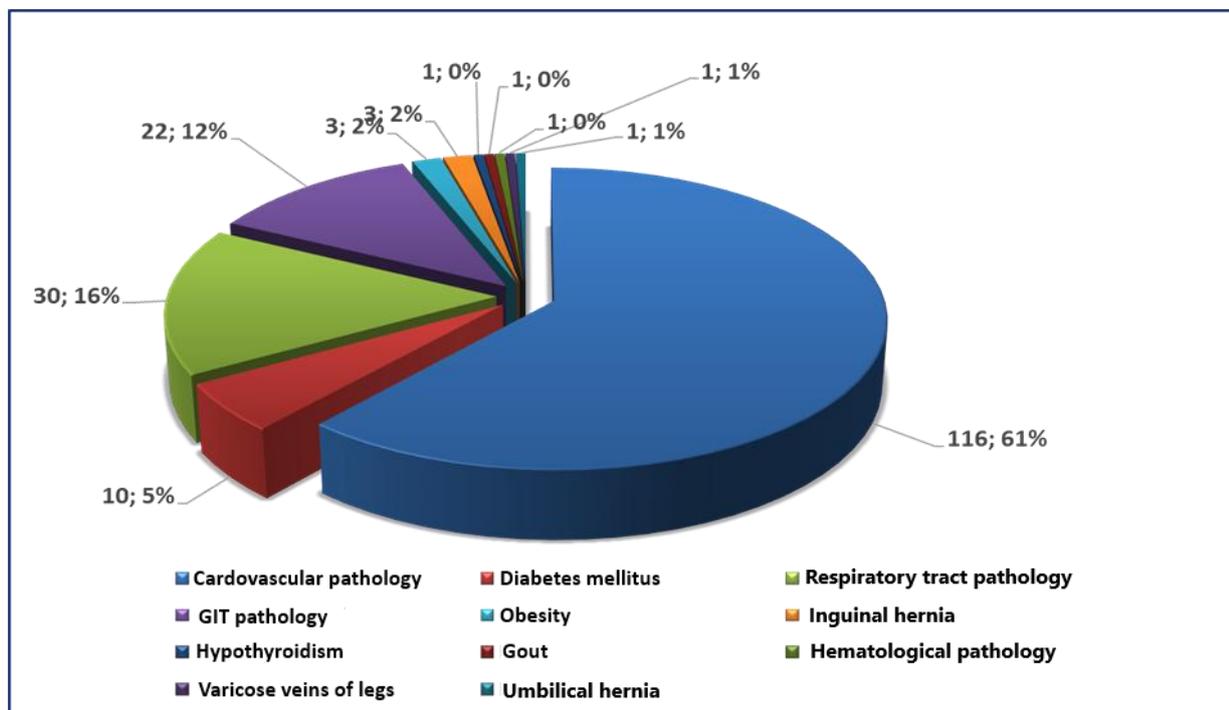


Fig. 2.1. Distribution of concomitant non-urological diseases in patients of three groups

In the preoperative period, if necessary, mandatory correction of concomitant non-urological diseases identified during anamnesis and examination was carried out. The identified non-urological diseases among patients of all groups are presented in the diagram, Fig. 2.1.

The identified urological diseases in patients of all groups are presented in the diagram, Fig. 2.2.

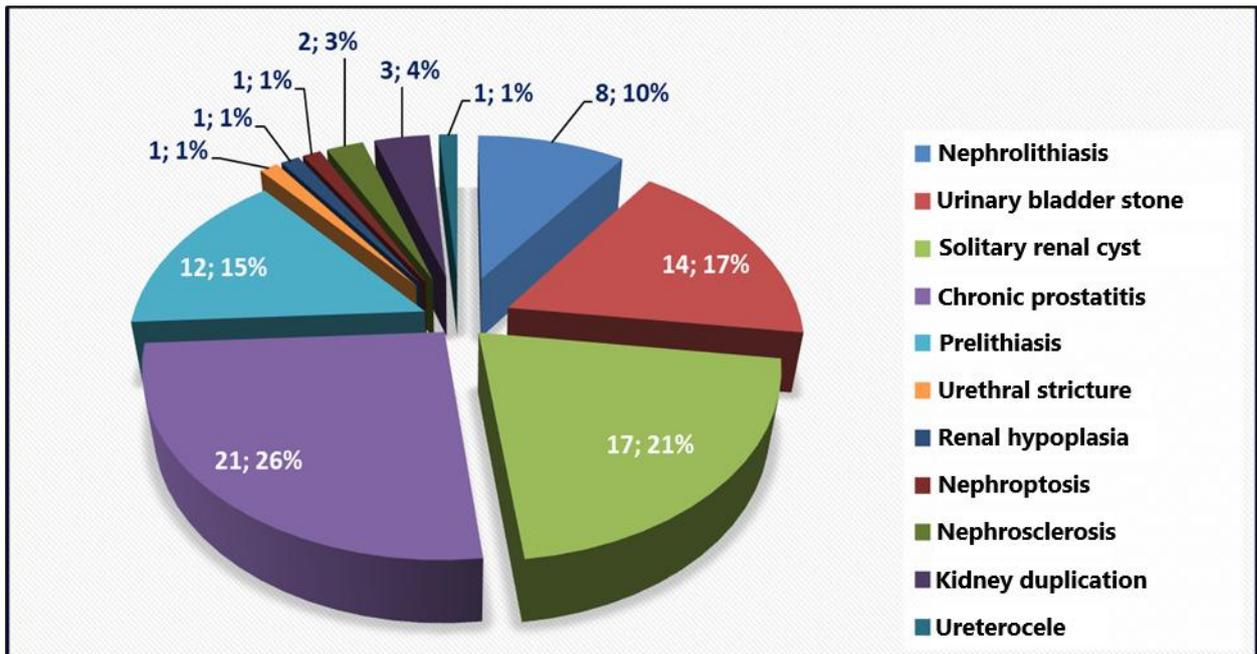


Fig. 2.2. Concomitant urological diseases identified in patients of three groups

It should be noted that in the first group there were 11 patients with a urethral catheter and 12 patients with cystostomy drainage, in the second group - 7 patients with a urethral catheter and 6 patients with cystostomy drainage, in the third group there were 7 patients with a urethral catheter and 17 patients with cystostomy.

Only after all the above studies were carried out, patients were sorted taking into account the inclusion and exclusion criteria.

Patient inclusion criteria.

- presence of BPH;
- normal PSA level or its acceptable increase, corresponding to the volume of the prostate gland;
- absence of suspicion of prostate cancer based on the results of digital rectal examination;
- absence of signs of active inflammatory process in the organs of the genitourinary system;
- IPSS score - 20 or higher, QoL - 3 or higher.
- Qmax <12 ml/sec.
- informed voluntary consent to surgical treatment.

Patient exclusion criteria.

- BOO caused by the urethral stricture or urinary bladder neck sclerosis;

- high PSA level or patients with suspected prostate cancer according to other research methods;
- presence of infectious-inflammatory diseases of the urinary tract in the stage of active inflammation;
- presence of obstructive and irritative urinary symptoms not associated with BPH;
- patients with an overactive, hypersensory bladder of a neurogenic nature;
- lack of informed consent (refusal) from surgery for BPH/LUTS;
- violation of the blood coagulation system or the inability to stop taking medications that affect blood clotting.

Dynamic observation after surgery was carried out at 1, 3 and 6 months.

The age of all 150 patients, that undergone surgery for BPH was 68.6 ± 0.6 years (49 to 89). In table 2.1. age data of patients distributed according to decades are presented.

Table 2.1.

Distribution of patients by age (n=150)

Age	Total 150	
	Abs.	%
49	1	0.7
50-59	20	13.3
60-69	53	35.3
70-79	67	44.7
80-89	9	6

The average age of patients in group I of patients who have undergone OPA (n=60) was 72.0 ± 0.9 years. In table 2.2. data on the analysis of the age composition of patients are presented.

Table 2.2.

Distribution of patients who have undergone OPA by age (n=60)

Age	OPA	
	Abs.	%
50-59	4	6.7
60-69	13	21.6
70-79	37	61.7
80-89	6	10

The average age of patients in group II, who have undergone TURP (n=50), was 67.5 ± 1.1 years.

Table 2.3.

Distribution of patients who have undergone TURP by age (n=50)

Age	TURP	
	Abs.	%
50-59	8	16
60-69	19	38
70-79	20	40
80-89	3	6

The average age of patients in group III who have undergone HoLEP (n=40) was 65.0 ± 1.1 years. 1 patient in this group was 49 years old. There were no patients in the age range of 80-89 years in this group.

Table 2.4.

Distribution of patients who have undergone HoLEP by age (n=40)

Age	HoLEP	
	Abs.	%
49	1	2.5
50-59	8	20
60-69	21	52.5
70-79	10	25

In table 2.5. all patients are distributed by age groups. According to table 2.5. it is necessary to indicate several clarifying facts. Patients of the first group, have undergone surgery in the Samarkand branch of the Republican Scientific Center for Emergency Medical Care in the period 2011-2018, when high-tech endoscopic interventions had not yet been introduced.

Table 2.5

Comparative assessment of the ages of patients operated on for BPH using different methods (n=150)

Age	OPA	TURP	HoLEP	Total
49	-	-	1	1
50-59	4	8	8	20
60-69	13	19	21	53
70-79	37	20	10	67
80-89	6	3	-	9
Total	60	50	40	150
Average age	72.0 ± 0.9	67.5 ± 1.1	65.0 ± 1.1	68.6 ± 0.6

Accordingly, surgery was performed on patients of all age groups if there were absolute indications for intervention. Some of the second group patients underwent TURP in 2018-2020 period, some of them in the private medical clinic “Bionur-medservis” in Samarkand. Patients of the third group underwent surgery in the Republican Scientific and Practical Medical Center of Urology during 2018, during the period of introduction of a new technique - the HoLEP operation.

The examination results (prostate volume and parameters assessing bladder outlet obstruction) in three groups of patients are presented in Table 2.6. and table 2.7.

Table 2.6.

Baseline patient data, n=150

Total, n	Prostate volume (cm³)	IPSS	QoL	Qmax (ml/s)	PVR (ml)
150	84.6±2.0	26.2±0.3	4.65±0.06	7.5±0.3	197.3±19.8

Average value of Qmax 7.5±0.3 ml/s was calculated in patients with preserved independent urination. In patients with cystostomy drainage, Qmax (art.) was calculated according to artificial uroflowmetry data in 17 patients from the HoLEP group and amounted to 20.1±2.8 ml/s. In patients with cystostomy from the OPA and TURP groups, artificial uroflowmetry was not performed due to the lack of techniques in these clinics.

Table 2.7.

Preoperative parameters of patients of all groups, n=150

No.	Index	OPA (n=60)	TURP (n=50)	HoLEP (n=40)
1.	IPSS	28.3±0.3	25.1±0.5	24.7±0.6
2.	QoL	4.75±0.1	4.6±0.1	4.5±0.1
3.	Qmax	6.6±0.3	6.9±0.3	10.9±1.1
4.	Vpr.	90.4±3.1	72.7±3.0	91.0±3.8
5.	PVR	246.2±28.9	203.3±37.7	77.2±15.8

IPSS (International Prostate Symptom Score) - International index of symptoms for prostate diseases

QoL (Quality of Life) - quality of life index

Qmax (maximum flow rate)- maximum urination rate

Vpr. - volume of the prostate

PVR - post-void residual urine

Standardization and objectification of the surgical results within groups was performed by the same operator.

When choosing a method of surgical treatment and associated anesthesia, it is necessary to correctly assess the preoperative physical condition of the patient. American Society of Anesthesiologists (ASA) physical status classification system is a convenient tool for this purpose. This anesthesia risk assessment system was proposed in 1941 and has undergone several modifications. The latest version was approved by the ASA on October 15, 2014 [168].

Taking into account age and concomitant diseases of the operated patients, the method of choice of anesthesia for surgical treatment of patients with BPH was spinal anesthesia (SA); in some patients, combined anesthesia or intubation anesthesia was used according to indications.

To prevent thromboembolic complications, all patients underwent elastic leg bandaging and administration of Clexane in a prophylactic dosage on the eve of the intervention and the first few days after it.

Before surgery, all patients were administered broad-spectrum antibiotics (fluoroquinolones or third-generation cephalosporins) once in a daily dosage to prevent infectious and inflammatory complications and were subsequently continued in the hospital. For patients with an initial infection of the urinary tract in the stage of active inflammation, antimicrobial therapy according to the antibiogram was started 2-3 days before surgery and continued in the postoperative period.

§2.2. Methods of surgical treatment

Open adenomectomy. Under spinal anesthesia, the surgical field (skin of the anterior abdominal wall from the pubis to the level above the navel, skin of the scrotum and surrounding areas) was cleaned three times with betadine solution. At the beginning, both-sided vasoresection is performed and the vas deferens is ligated. An aseptic bandage is applied to the skin of the scrotum, after which the main stage of the operation began. An 8 cm long Pfannenstiel skin incision is made in the suprapubic region.

Hemostasis is achieved using electrocoagulation. An incision is made on the aponeurosis of the rectus abdominis muscle. The rectus abdominis muscles are pushed apart bluntly. The transversus abdominis fascia is opened. The fold of parietal peritoneum covering the bladder is pushed upward using a tampon and the anterior wall of the bladder is mobilized. The wall of the bladder is taken on 2 catgut holders and opened in the longitudinal direction along the detrusor fibers. An inspection of the bladder cavity is performed (Fig. 2.3). After inspection the surgeon put on an additional sterile glove on his left hand and bimanually, while pushing the adenoma with the index finger of his left hand through the wall of the rectum towards the bladder, enucleates adenomatous nodes through the bladder with his right index finger (Fig. 2.4, 2.5).



Fig. 2.3. Revision of the bladder cavity



Fig. 2.4. Enucleation of adenomatous nodes



Fig. 2.5. Removed adenomatous nodes



Fig. 2.6. Packing of the adenoma bed

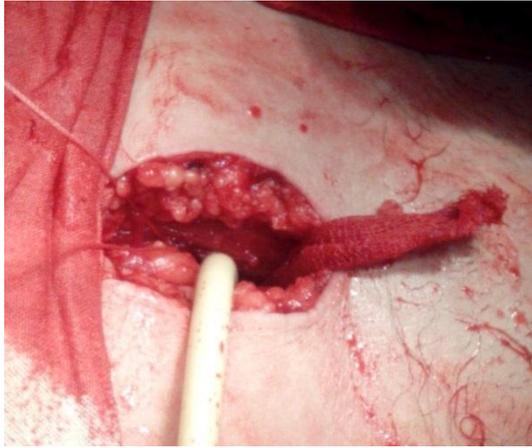


Fig. 2.7. The end of the tampon is brought out



Fig. 2.8. Foley catheter inserted

Bleeding from the bed of the removed adenoma was stopped using a gauze swab (Fig. 2.6, 2.7). A 2-way hemostatic catheter 22 Ch was installed through the urethra into the bladder. A cystostomy drainage (Foley or Pezzer catheter) was left through the anterior wall of the bladder in its cavity (Fig. 2.8). The bladder wall was sutured with catgut using a continuous suture. A flushing system with isotonic solution was installed through a urethral Foley catheter to prevent the formation of clots and dysfunction of the drainage systems. The wound was sutured layer by layer. Stitches on the skin. Aseptic wound bandage.

Transurethral resection of the prostate (TURP). TURP is performed under spinal anesthesia. The external genitalia were cleaned three times with a 70% alcohol solution. A 17 Fr cystoscope is inserted into the urethra. The surgeon visually examined the urethra, the extent of BPH, the verumontanum and the bladder neck. Next, an inspection of the bladder cavity, the orifice area and visualization of the release of clear urine was performed. The cystoscope is removed and a 24 Ch resectoscope is inserted through the urethra. Usually, resection of prostate adenoma was performed using a standard technique against the background of constant irrigation of the bladder with isotonic sodium chloride solution. Layer-by-layer resection was performed alternately along the right and left walls, the upper and lower lobes of BPH under visual control of the verumontanum. When performing layer-by-layer resections, if necessary, coagulation of bleeding vessels was carried out using coagulation loops. At the end of the operation, the bladder cavity was washed from the remains of blood clots and adenoma tissue. Against the background of clear fluid and the absence of active bleeding,

the resectoscope was removed, after which a 3-way hemostatic Foley catheter 22-24 Ch was installed along the urethra, the catheter balloon was inflated with a sterile isotonic solution in a volume that corresponded to the removed volume of BPH and light tension on the catheter was ensured to remote hemostasis. A flushing system was installed on the operating table to prevent the formation of blood clots and drainage dysfunction. Aseptic bandage on the glans penis around the catheter and the external opening of the urethra.

Holmium laser enucleation of the prostate and technical characteristics of the equipment. HoLEP operation was performed in an endourology operating room in compliance with safety regulations when working with laser radiation sources.

Endourological operating room equipment that was used to perform transurethral interventions:

- Operating table;
- Endoscopic stand (Karl Storz);
- White light source;
- High-frequency electric current generator;
- Suspended tanks with saline solution;
- Cabinets for storing tools;
- Mobile tables for tools;
- Necessary equipment for performing anesthesia.

HoLEP was performed using a 26 Ch Karl Storz resectoscope (Germany) with continuous irrigation and a working element equipped with a channel for a laser fiber.

Tools required to perform the HoLEP operation:

- Urethral calibrator;
- 28 Ch outer tube with continuous irrigation system;
- Internal “rotational” tube;
- Optical obturator;
- Optical system 12°;
- A working element equipped with a channel for laser fiber.

Transurethral laser enucleation of the prostate was performed using an “Accu Tech Holmium Medical Laser” laser unit (China) at the Republican Specialized Scientific and Practical Medical Center of Urology (Tashkent) (Fig. 2.9). Enucleated prostate hyperplasia tissue was crushed in the bladder and evacuated using a morcellator Karl Storz (Germany). A morcellator is a transurethral probe that has rotating

blades at the end and allows the evacuation of crushed tissue. The tissue removed during surgery was measured using electronic scales.

The interventions were performed on the operating table, which made it possible to change the height of the patient's position and raise the leg or head end. To carry out the intervention, the patient was placed on the table in a position with legs apart and bent at the hip and knee joints, the so-called lithotomy position.



Fig. 2.9. Accu Tech Holmium Medical Laser (China)

HoLEP procedure was performed using a technique authored by the creator of holmium enucleation of the prostate, Peter Gilling. The essence of the technique is laser exfoliation of all lobes of hyperplastic prostate tissue, moving them to the bladder, subsequent morcellation and evacuation of adenomatous tissue (Fig. 2.10).

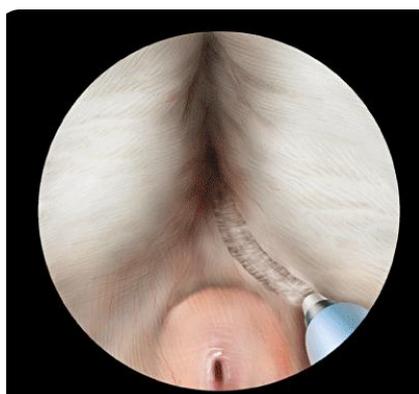
Initially, after treating the external genitalia with an antiseptic solution, cystoscopy is performed. It is performed immediately before enucleation and its purpose is a thorough inspection of the bladder for the presence of concomitant pathology (tumors, bladder stones), visualization of the ureteral openings, determination of the size of hyperplasia, marking of the operation area, determination of spatial landmarks for future enucleation.

After this, surgery is proceeded directly to the enucleation stage. It begins with a bilateral dissection of the mucous membrane of the urinary bladder neck in the direction from the neck to the verumontanum. The formed incisions are deepened until the surgical capsule of the adenoma

is reached on the right and left sides of the middle lobe. If there is no middle lobe, it is possible to make one cut at 6 o'clock on the conventional dial.

After both cuts on the sides of the middle lobe are formed, directly above the spermatic tubercle they are combined with each other. By moving the laser fiber from side to side, the middle lobe is completely separated from the surgical capsule and moved into the bladder cavity.

Next comes the stage of enucleation of the lateral lobes of prostatic hyperplasia. To do this, a distal dissection of the bladder neck is performed and the incision continues in a downward and outward direction and continues to the level of the seminal tubercle. It is necessary to move strictly in the desired layer, within the surgical capsule, if necessary, mechanically moving the enucleated tissue with the end of the resectoscope for better orientation in the layer. In this case, the lower edge of the lateral lobe of hyperplasia at the apex of the prostate gland is first released, and then the incision is made in the direction of 2 o'clock, and the lobe is gradually separated from the surgical capsule. Then an incision is made at 12 o'clock and continues until connected to the previous one. This way the lobe is completely separated and can be moved towards the bladder. A similar technique is used on the other side. Current practice is to cut off the bladder neck mucosa early to protect the sphincter and prevent postoperative urinary incontinence.



Formation of a groove at 5 o'clock on the conventional dial



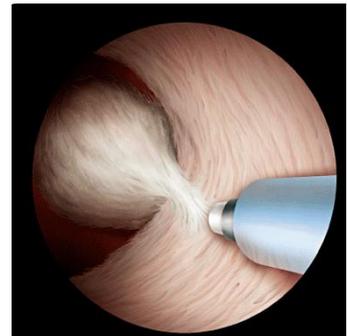
Merging the grooves with subsequent movement of the enucleated middle lobe into the bladder



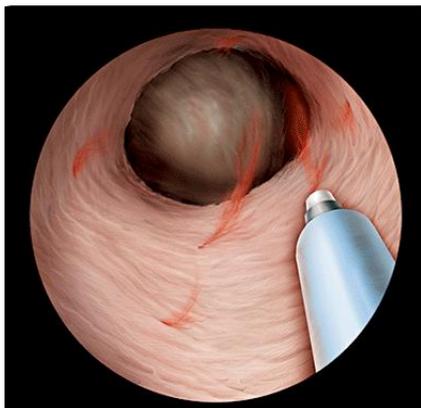
Enucleation of the right lateral lobe



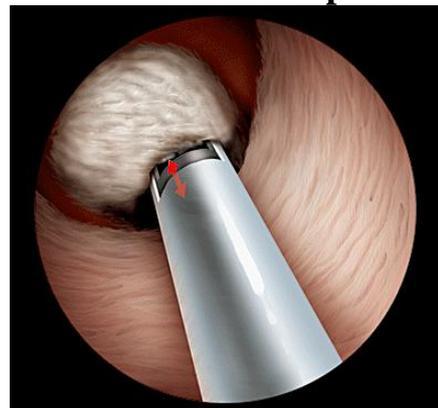
Separation of hyperplasia tissue from the capsule



The lateral lobe is separated from the capsule



Performing hemostasis



Morcellation

Fig. 2.10. Stages of holmium laser enucleation (Gilling P., 2008) [169]

After enucleation of hyperplasia tissue, it is necessary to completely stop bleeding from the bed of the enucleated adenoma. Hemostasis is achieved by laser coagulation of blood vessels. If necessary, laser hemostasis is supplemented with electrocoagulation using a resectoscope loop. The next stage of the operation is morcellation of the enucleated tissue. In this case, the grinding and evacuation of removed tissues is carried out using a morcellator.

Morcellation should be started only after the bleeding from the adenoma bed has completely stopped, because inadequate visualization can cause a serious complication - the bladder wall getting into the morcellator window and, accordingly, its damage. The safety of the morcellation stage can only be achieved if the above rules are observed. The rate of morcellation depends on the density of the hyperplasia tissue, the presence of any fragments or inclusions.

After completion of the grinding, the morcellator is removed, and a three-way urethral Foley catheter is left in the cavity of the bladder. If necessary, using this catheter you can rinse the bladder cavity.

§2.3. Classification of postoperative complications

To systematize postoperative complications of surgical methods for treating BPH, the modified classification of Clavien P.A. and Dindo D. (2004) was adapted specifically for this format of interventions:

I grade - any deviations from the normal postoperative period that do not require pharmacological therapy or surgical endoscopic and radiological intervention. Only a therapeutic regimen is carried out: namely, antiemetics, antipyretics, analgesics, diuretics, electrolytes and physiotherapy. This also includes treatment of hospital-acquired wound infections;

II grade – complications requiring drug therapy with drugs other than those allowed for stage I. This degree includes blood transfusion and total parenteral nutrition;

III grade – surgical, endoscopic or radiological intervention is required:

III a grade – interventions that are performed without general anesthesia;

III b grade – interventions that are performed under general anesthesia;

IV grade – life-threatening complications (including complications from the central nervous system), requiring the patient to stay in the intensive care unit;

IV a grade – failure of one organ function (including dialysis);

IV b grade – multiple organ failure;

V grade – patient's death [21].

§2.4. Calculating of blood loss volume

When performing endourological interventions, the volume of blood loss can be calculated in several different ways. We used the following formula:

$$\mathbf{V \text{ blood loss} = \frac{\text{CHb blood} * \text{V solution}}{\text{CHb solution}}}$$

where V blood loss is the volume of blood loss (ml); V solution - volume of irrigation fluid (ml); CHb in solution - hemoglobin content in the irrigation fluid; CHb in blood - hemoglobin in the blood.

In some patients, in cases where bleeding continued after surgery, we assessed blood loss by the number of red blood cells, hemoglobin level, hematocrit, color index, which were determined before surgery and on the first day, as well as on days 3 and 7 after surgery. The degree of blood loss was determined by the level of decrease in hemoglobin concentration.

§2.5. Statistical analysis of results

Statistical analysis was performed on a personal computer using Microsoft Excel 2019 software. Student's, Fisher's and chi-square tests were used for data processing. Differences were considered statistically significant at $p < 0.05$.

CHAPTER III. RESULTS OF SURGICAL TREATMENT OF PATIENTS WITH BPH AFTER OPEN ADENOMECTIONY, TRANSURETHRAL RESECTION AND HOLMIUM ENUCLEATION OF THE PROSTATE

3.1. Adaptation of the Clavien-Dindo classification to the assessment of postoperative complications of surgical treatment of benign prostatic hyperplasia

Practicing urologists know that after any surgical intervention it is possible to develop complications of varying severity. There is still no consensus in urological medical community on how to correctly identify complications and assess their severity. The most commonly used complications classification system is a Clavien-Dindo system. In urology also used Comprehensive Complication Index (CCI) [170]. This makes it difficult to make reliable and reproducible comparisons of different treatments within a single center, within a center over time, or to compare the results of identical treatment modalities between different centers using similar or different approaches. Therefore, a standardized platform for classification of complications is required for urologists collaboration.

Any surgical intervention may be accompanied by the development of complications. This applies to both traditional open interventions and minimally invasive transurethral procedures undertaken for BPH. Some severe complications are life-threatening and require the patient to stay in the intensive care unit. A number of complications that can be classified as "mild" or "moderate" do not pose a threat to the patient's life, but can significantly worsen the man's quality of life even after the elimination of infravesical obstruction. All complications should be carefully monitored and documented. Regarding postoperative complications of surgical methods for the treatment of BPH: a unified approach approved by the urological community is needed, which would allow complications to be systematized by different specialists in different centers without the inaccuracies that exist today.

The Clavien-Dindo classification for systematizing postoperative complications is inherently universal and applicable to all types of surgical interventions. But it is necessary to take into account that this

classification system requires adaptation to a particular method of surgical treatment, taking into account the characteristics of the disease and the specifics of surgical intervention. Regarding surgical treatment of BPH - to adapt the classification, it was necessary to develop criteria of the normal (standard) and complicated postoperative course in BPH surgical treatment.

Modified Clavien-Dindo classification of surgical complications was adapted for assessment of postoperative complications of surgical treatment of BPH and subsequently to systematization complications, Table. 3.1.1.

Table 3.1.1.
Modified Clavien-Dindo classification of surgical complications [21]

Grade	Criteria
I	Any deviations from the normal postoperative period that do not require surgical, endoscopic and radiological intervention. Only conservative therapy is carried out - antiemetics, antipyretics, analgesics and diuretics, administration of electrolytes, physiotherapy, as well as treatment of a wound infection that opened in the hospital
II	Includes complications that require expanding the scope of drug therapy (in addition to the drugs indicated for complications I degrees), as well as blood transfusions and total parenteral nutrition
III	Complications requiring surgical, endoscopic or radiological intervention are divided into:
IIIa	interventions performed without general anesthesia
IIIb	interventions performed under general anesthesia
IV	Life-threatening complications (including CNS), requiring the patient to remain in the intensive care unit and including:
IVa	single organ failure (including dialysis)
IVb	multiple organ failure
V	Death of the patient

In our opinion, the proposed standard of normal course of the postoperative period should be the same for both open surgery and minimally invasive transurethral methods of surgical treatment of BPH. This will ensure objectively assessing the quality of surgical interventions for BPH and correctly identifying the shortcomings of a

particular treatment method according to a uniform system for recording postoperative complications.

Based on many years of experience of our clinics in the treatment of BPH and postoperative management of patients, we have created criteria for normal, i.e. uncomplicated postoperative period, table. 3.1.2.

Table 3.1.2.

**Standard course of the postoperative period during surgical treatment of BPH
[163, 164]**

- insignificant (nonintensive) staining of urine with blood through the urethral catheter and/or cystostomy, without forming blood clots and impaired drainage function, without additional infusion (more than 1 liter), diuretic therapy and hemostatics;
- continuous drip-irrigation of the bladder up to 36 hours after surgery;
- an increase in the patient's body temperature to 37.9°C without chills for no more than 48 hours, which does not require antipyretic or infusion therapy (more than 1 liter);
- remaining of intraoperatively inserted hemostatic urethral catheter from 12 to 72 hours (as directed by the surgeon) without the development of an infectious-inflammatory process in the urinary tract (UTI) and the need for additional interventions;
- remaining of cystostomy drainage up to 5 days after surgery;
- transient urinary incontinence for up to 1 month in the absence of urinary tract infection.

Each item from Table 3.1.2 carries a certain meaning and is introduced on the basis of the enormous knowledge and experience of our team in the field of surgical treatment and postoperative management of patients with BPH.

For objective and accurate systematization of postoperative complications, it is important to understand what is normal for the postoperative period of BPH surgical treatment and what is considered a complication. In this regard, the criteria for the normal (standard) course of the postoperative period of BPH surgical treatment (Table 3.1.2) allow us to accurately mark the boundary when we can talk about the occurrence of a complication and register it. Based on this, were proposed criteria for assessing postoperative complications by their severity.

At the same time, the severity of the postoperative complication that arose was classified based on the measures taken to eliminate this

complication, i.e. in accordance with the logic of the Clavien-Dindo classification system and its 5 grades.

In our opinion, in clinical practice, more new complications may be observed or appear, which must be added to the classification based on their severity. The main thing is that we have determined the boundary of the uncomplicated postoperative period and the beginning of the complicated course.

Difficulties may arise in classifying the so-called "mild" complications of grades 1 and 2 and determining the exact boundary between them. The solution to this issue is seen in using the mentioned above criteria for an uncomplicated postoperative period, based on which an exact gradation of any complication by severity is possible.

Summary

For accurate systematizing of postoperative complications in the surgical treatment of BPH and to ranging complications due to Clavien-Dindo classification system, it is necessary to determine standard criteria for the course of the postoperative period, which will make it possible to determine the boundary between uncomplicated and complicated postoperative course.

3.2. The nature, frequency and causes of intra- and postoperative complications of open adenectomy in patients with BPH, taking into account volume of the prostate, risk of intervention according to ASA and systematization of postoperative complications

Analysis of the results of a clinical examination of patients performed in accordance with the standard for examining patients with IVO showed that at middle age 71.98 ± 0.9 years, the average volume of the pancreas was 90.4 ± 3.1 cc. Analysis of points scored on the international questionnaire for assessing prostate symptoms, quality of life, assessment of urination parameters and laboratory test data showed the following picture, Table 3.2.1.

Table 3.2.1.

Initial data of patients of group I (OPA), n=60

Indicators	OPA
Age	72.0±0.9
BMI (kg/m ²)	24.6±0.3
Prostate volume (transrectal ultrasound)	90.4±3.1
IPSS	28.3±0.3
QoL	4.75±0.1
Qmax (ml/s) derived by multiplying by 3 Qaver (ml/s)	6.6±0.3
Qaver (ml/s) (by stopwatch)	2.2±0.1
Vres (ml)	246.2±28.9
Blood Hb (g/l)	90.5±1.1
Creatinine (µmol/l)	96.8±1.5
Urea (mmol/l)	7.6±0.2

According to the preoperative examination by the anesthesiologist, the patients were assigned anesthesia risk grades according to ASA, where the vast majority of patients had a grade II risk (80%), a grade III risk was noted in 20% of patients, Table. 3.2.2.

Table 3.2.2.

Distribution of patients according to the degree of anesthesia risk according to ASA in the OPA group

ASA grade	OPA (n=60) n (%)
I grade	-
II grade	48 (80)
III grade	12 (20)
IV grade	-
V grade	-

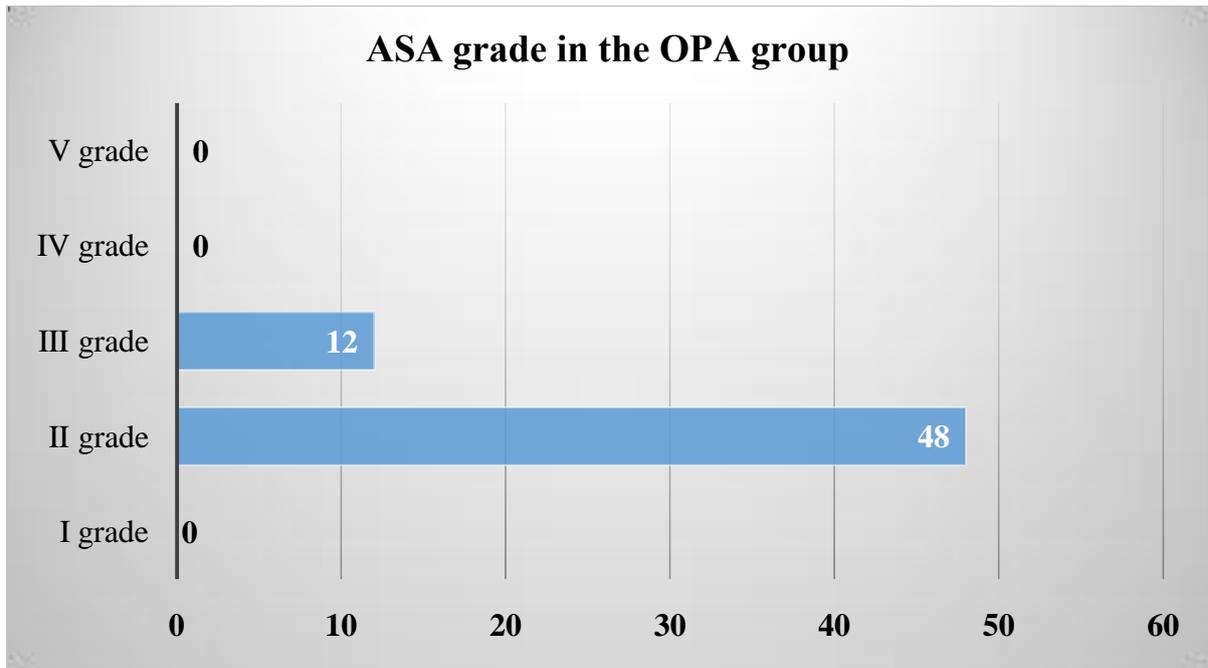


Fig. 3.1. Quantitative ratio of patients who have undergone OPA by ASA grade

Analysis of the results of the surgical intervention showed that the operation time was on average less than 1 hour, with an average volume of removed adenomatous tissue of 81.9 g. the average intraoperative blood loss was 287.5 ml (Table 3.2.3.).

Table 3.2.3.

**Intra- and postoperative parameters of group I patients (OPA),
n= 60**

Operation time, (min), M±m	56.6±2.2
Volume of removed tissue, (g) M±m	81.9±3.9
Frequency of intraoperative bleeding, with a blood loss volume of 700 ml, (%)	5 (8.3%)
Intraoperative blood loss, (ml), M±m	287.5±16.7
Duration of hematuria in the postoperative period (days), M±m	3.8±0.3
Duration of stay of the tampon in the BPH bed, (days) M±m	2.9±0.7
Duration of cystostomy after intervention, (days), M±m	4.6±0.3
Duration of stay of the urethral catheter after the intervention, (days), M±m	8.4±0.3
Hospital stay after surgery, (days), M±m	8.6±0.3

As can be seen from Table 3.2.3, 5 (8.3%) patients experienced an intraoperative complication in the form of intense bleeding, which was stopped by tamponing the bed of the removed adenoma. In 4 patients hemotransfusion in early postoperative period was performed. No other intraoperative complications were observed.

Surgeons removed the tampon from the BPH bed on average 3 days after the intervention (2.9 ± 0.7), while first of all the surgeons removed the cystostomy drainage for faster and better healing of the suprapubic fistula and only, on average, after 8.4 ± 0.3 days, removed the urethral catheter, and the patient urinated on his own.

Analysis of the postoperative period of the first group of patients who have undergone OPA, taking into account the standard postoperative course, identified 154 (256.6%) cases of deviations from the normal postoperative period, which were regarded as a complicated course. Postoperative complications of varying severity occurred in all 60 patients (100%). We assessed the following complications:

Complications of grade I were observed in 89 (57.8%) cases out of 154 and included:

Acute urinary retention (failed TWOC (trial without catheter))	3
One-day fever above 38°C or febrile fever (37-38°C) for more than 2 days, requiring prescription of antipyretic drugs	1
Bloating and intestinal paresis, which required the prescription of drugs that reduce gas formation and a cleansing enema	5
Urine leaking around cystostomy drainage up to 2 days	9
Transient increase of creatinine level	2
Nausea, single vomiting	1
Wound infection	2
Remaining of cystostomy drainage for more than 5 days	6
Remaining of urethral catheter for	60

more than 72 hours	
--------------------	--

Grade II complications were observed in 48 (31.2%) cases out of 154:

Intense blood staining of urine, hypovolemia due to bleeding, requiring hemostatics and/or additional infusion therapy	15
Hemotransfusion	4
Need for analgesics more than 72 hours after surgery	12
Prescription of narcotic analgesics in connection with an intervention	1
Infectious-inflammatory processes in the urinary tract: <ul style="list-style-type: none">• acute pyelonephritis• urethritis• orchiepididymitis	6 2 2 2
Urine leaking around the cystostomy drainage for more than 2 day	3
Urinary leakage into the scrotum	1
Exacerbation of chronic concomitant pathology or developed complications after surgery and anesthesia: <ul style="list-style-type: none">• bacterial conjunctivitis• exacerbation of chronic bronchitis• hypoxic encephalopathy, with the development of psychosis	6 1 3 2

IIIa degree of complications was detected in 9 (5.8%) cases out of 154:

Urine leakage after cystostomy removal, requiring recatheterization with a urethral catheter	1
--	---

Bladder outlet obstruction due to blood clots, requiring lavage of the bladder and drainage tubes	2
Non-functioning cystostomy, which required repositioning of the drainage, lavage of the bladder and drainage tubes	1
Partial obstruction of the drainage, requiring recystostomy (without anesthesia)	1
Urinary bladder tamponade, requiring:	2
• cystoscopy	1
• urinary bladder lavage under local anesthesia	1
Erosive gastritis, requiring esophagogastroduodenoscopy	1
Persistent intestinal paresis that required the installation of a gas outlet tube	1

Grade IIIb complications were observed in 3 (1.95%) cases out of 154 (late complications):

Posterior urethra stricture, in 1 case – stricture with urinary bladder stone (emergency epicystolithostomy)	2
Urinary bladder neck sclerosis (cystotomy)	1

IVa degree of complications was detected in 3 (1.95%) cases out of 154:

Cardiovascular failure requiring transfer to ICU	2
Ischemic stroke, requiring transfer to ICU	1

V degree - after OPA 2 (1.3%) patients died:

Death of the patient	2
• after acute cardiovascular failure	1
• after ischemic stroke	1

The general picture of the systematization of postoperative complications was as follows, Table 3.2.4, Fig. 17.

Table 3.2.4.

Systematization of postoperative complications in OPA according to the adapted Clavien-Dindo classification, a total of 154 complications

I grade	II grade	IIIa grade	IIIb grade	IVa grade	IVb grade	V grade
89 (57.8%)	48 (31.2%)	9 (5.8%)	3 (1.95%)	3 (1.95%)	0	2 (1.3%)

**p<0.05 compared with the preoperative period.*

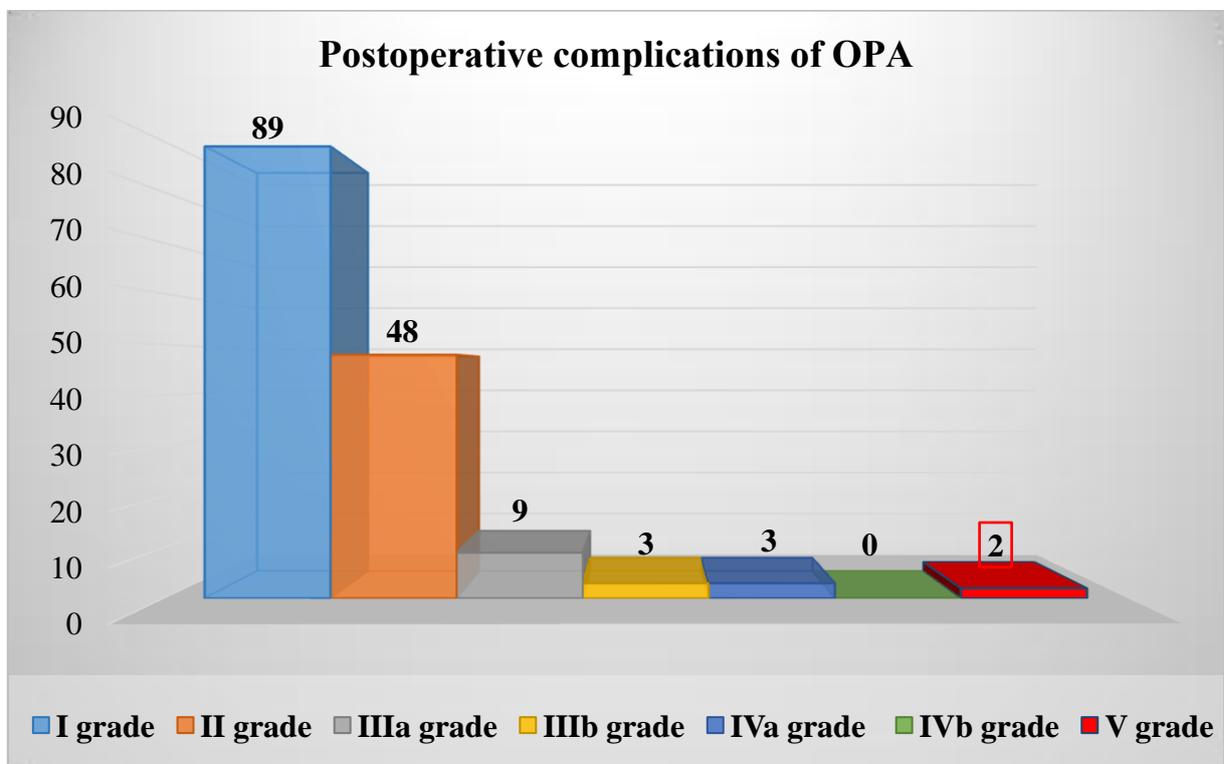


Fig. 3.2. Distribution of postoperative complications of OPA depending on their severity

Thus, among 60 patients who have undergone OPA, only 154 (256.6%) complications were observed in the postoperative period. Of all complications, 137 (89%) were relatively mild and were managed conservatively. 12 (7.8%) complications were classified as grade IIIa (9 (5.8%)) and IIIb (3 (1.95%)) complications. To manage these complications, invasive interventions were used under local (IIIa) or general (IIIb) anesthesia.

There were 3 (1.95%) severe complications of grade IVa, for which patients received treatment in the intensive care unit (ICU). Two patients died.

The analysis of IPSS score, quality of life index, volume of the prostate and volume of residual urine, as well as the maximum urine flow rate in 1, 3 and 6 months after OPA is presented in Table 3.2.5.

As can be seen from the table 3.2.5. out of 60 patients, due to 2 cases of death in the early postoperative period, 58 patients were observed for 6 months. At the same time, in 55 (91.7%) patients the result of the intervention was assessed as effective. In the long-term period, 3 (1.95%) fibrosclerotic changes developed in the posterior urethra and in the bladder neck, which required additional surgical interventions

Table 3.2.5.

**Efficiency of treatment in patients with BPH, who have undergone OPA
(n=58)**

No.	Index	Before surgery	1 month after surgery	3 months after surgery	6 months after surgery
1.	IPSS	28.3±0.3	7.5±0.1*	6.6±0.2*	5.7±0.1*
2.	QoL	4.75±0.1	3.05±0.05*	2.1±0.04*	1.9±0.05*
3.	Qmax	6.6±0.3	19.8±0.2*	20.4±0.3*	21.3±0.3*
4.	Vpr.	90.4±3.1	27.4±0.7*	25.7±0.7*	24.6±0.6*
5.	PVR	246.2±28.9	23.9±2.2*	20.2±1.7*	15.0±1.45*

Summary

Open adenectomy turned out to be a rather traumatic method of surgical treatment of BPH. At the same time, the frequency of intraoperative bleeding was 5 (8.3%), the average intraoperative blood loss was 287.5±16.7 ml, postoperative hospital stay was 8.6±0.3 days.

Systematization of postoperative complications according to the adapted Clavien-Dindo classification system demonstrated the features of the postoperative period of OPA and revealed those shortcomings that remained unnoticed during the usual assessment of interventions. Unified criteria allowed us to determine accurately all the complications and higher overall incidence of complications owing to the inclusion of all the minor complications (grade I and II)

At the same time, taking into account the initial risk of intervention according to ASA II degree in 80% and III degree in 20% of patients, the frequency of blood transfusion was 4 (6.7%), the total frequency of infectious and inflammatory complications (urinary tract and other organs) was 10 (16.7%), the total frequency of complications requiring repeated invasive and reconstructive surgical interventions in the postoperative period was 12 (7.8%), mortality 2 (3.3%) and treatment effectiveness was 91.7%.

3.3. Nature, frequency and causes of intra- and postoperative complications of transurethral resection of BPH, taking into account volume of the prostate, risk of intervention according to ASA and systematization of postoperative complications

Analysis of the results of a clinical examination of patients performed in accordance with the standard for examining patients with IVO showed that at middle age 67.5 ± 1.1 years, the average volume of the prostate was $72.7 \pm 3.0 \text{ cm}^3$. Analysis of IPSS score, quality of life index, urination parameters and laboratory tests results showed the following, Table 3.3.1.

Table 3.3.1
Preoperative parameters of the II group patients (TURP),
n= 50

Parameters	TOUR BPH
Age	67.5 ± 1.1
BMI (kg/m ²)	25.8 ± 0.4
Prostate volume (transrectal ultrasound)	72.7 ± 3.0
IPSS	25.1 ± 0.5
QoL	4.6 ± 0.1

Qmax (ml/s) calculated by multiplying by 3 Qaver	6.9±0.3
Qaver (ml/s) (by stopwatch)	2.3±0.1
Vres (ml)	203.3±37.7
Blood Hb (g/l)	117.6±3.5
Creatinine (μmol/l)	92.0±3.3
Urea (mmol/l)	7.1±0.3

Table 3.3.2.

Distribution of patients according to the degree of anesthesia risk according to ASA in the TURP group

ASA grade	TURP (n=50) n (%)
I grade	-
II grade	32 (64)
III grade	18 (36)
IV grade	-
V grade	-

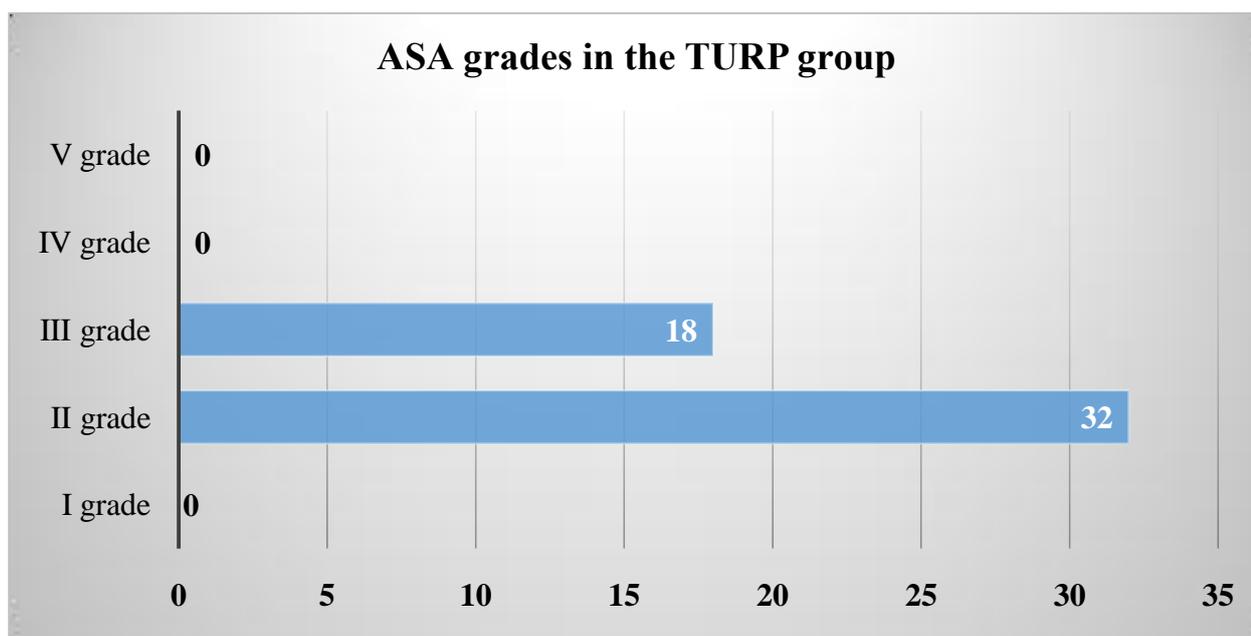


Fig. 3.3. Distribution of patients in the TURP group according to ASA grade

Table 3.3.3

Intra- and postoperative parameters of II group patients (TURP BPH), n= 50

Indicators	TURP BPH
Operation time (min), M±m	78.4±4.9
Volume of removed tissue (g), M±m	56.1±3.8

Frequency of intraoperative bleeding more than 700 ml, (%)	1 (2.0%)
Intraoperative blood loss (ml), M±m	54.2±9.5
Duration of hematuria in the postoperative period (days), M±m	1.35±0.08
Duration of stay of the urethral catheter after the intervention (days), M±m	2.9±0.1*
Duration of cystostomy after intervention (days), M±m	2.9±0.5**
Hospital stay after intervention in intensive care (days), M±m	2 patients (one 8 hours, the other 17 hours)
Hospital stay after surgery (days), M±m	3.3±0.2

* 6 patients were discharged with a urethral catheter within 2 to 7 days.

** Designed for 10 patients with a cystostomy (6 had a cystostomy before surgery), another 4 had a cystostomy installed in the hospital for various reasons (severe intraoperative bleeding or expected bleeding due to a large adenoma).

According to the preoperative examination by the anesthesiologist, the risk of anesthesia was determined according to ASA grades. 32 (64%) patients had a II grade risk of, 18 (36%) patients had a III grade risk, Table. 3.3.2. and Fig 3.3.

Analysis of the results of surgical intervention showed that the average TURP operation time was 78.4±4.9 min, with the volume of removed adenomatous tissue 56.1±3.8 gr. The average intraoperative blood loss was 54.2±9.5 ml (Table 3.3.3).

As can be seen from Table 3.3.3, the incidence of intraoperative bleeding was 1 (2.0%) case. Due to the peculiarities of minimally invasive TURP of BPH with intraoperative coagulation of bleeding vessels, the duration of hematuria in the postoperative period was less than 1.5 days. Remaining of the urethral catheter in the adenoma bed and drainage of the bladder through a cystostomy (in some patients) turned out to be less long and amounted to 2.9±0.1 days.

Analysis of the postoperative period of II group patients, the frequency and severity of complications according to the criteria for uncomplicated and complicated course of the postoperative period revealed 41 (82.0%) complications among 50 patients.

Grade I complications were observed in 16 (39%) of 41 cases and included:

Acute urinary retention (failed TWOC)	2
Urine leaking after removal of cystostomy drainage	1
Remaining of cystostomy drainage for more than 5 days	1
Remaining of urethral catheter for more than 72 hours	11
Intestinal paresis, requiring a cleansing enema and additional medications	1

Grade II complications were observed in 17 (41.5%) cases out of 41:

Intense blood staining of urine, hypovolemia due to bleeding, requiring hemostatics agents and/or additional infusion therapy	10
Bleeding requiring hemotransfusion	2
Need for analgesics more than 72 hours after surgery	1
Exacerbation of an infectious-inflammatory process in the urinary tract (urethritis)	4

Grade IIIa complications were identified in 1 (2.4%) case out of 41:

Urine leakage after cystostomy removal, requiring recatheterization with a urethral catheter	1
--	---

Complications of IIIb degree were identified in 7 (17.1%) cases out of 41:

Urinary bladder tamponade	3
---------------------------	---

(cystoscopy for bladder blood clot evacuation)	
<i>Late complications</i>	
Stricture of the posterior urethra	2
Urinary bladder neck sclerosis	2

Complications of IVa, IVb and V degrees were not noted.

Table 3.3.4

Systematization of the postoperative complications of TURP according to the adapted Clavien-Dindo classification, n=41

I grade	II grade	IIIa grade	IIIb grade	IVa grade	IVb grade	V grade
16 (39%)	17 (41.5%)	1 (2.4%)	7 (17.1%)	0	0	0

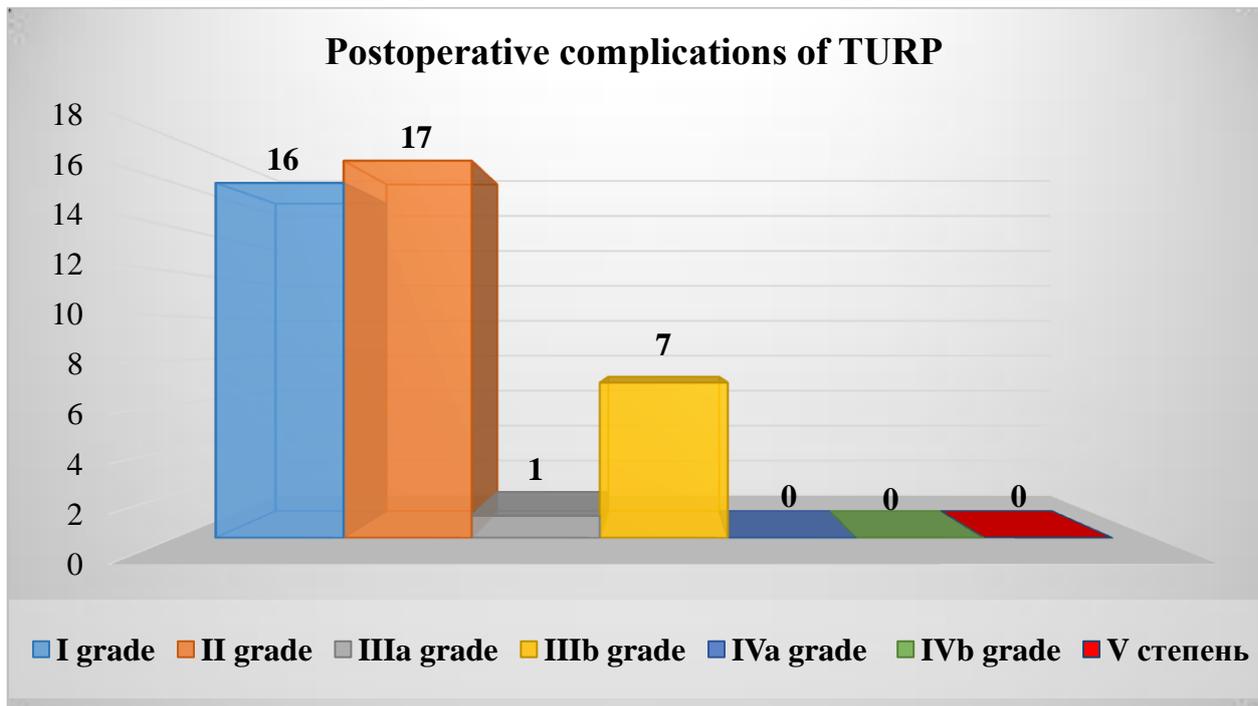


Fig. 3.4. Distribution of postoperative complications of TURP depending on their severity

Thus, among 50 patients who have undergone TURP in the postoperative period, only 41 (82.0%) complications were observed in 30 patients. There were 33 (80.5%) complications of I and II degree, which were eliminated conservatively. Relatively severe complications

included 8 (19.5%), the elimination of which required invasive interventions, of which (17.1%) were performed under general anesthesia.

Table 3.3.5.

Efficacy of treatment in patients with BPH undergoing TURP

No.	Index	Before surgery	1 month after surgery	3 months after surgery	6 months after surgery
1.	IPSS	25.1±0.5	10.6±0.35*	7.8±0.1*	6.2±0.2*
2.	QoL	4.6±0.1	3.98±0.1*	3.1±0.05*	2.1±0.04*
3.	Qmax	6.9±0.3	17.9±0.2*	19.5±0.2*	20.3±0.2*
4.	Vpr.	72.7±3.0	30.0±0.8*	28.1±0.7*	26.7±0.6*
5.	PVR	203.3±37.7	28.2±2.65*	22.3±1.7*	17.9±1.4*

**p<0.05 compared with the preoperative period*

The effectiveness of the surgical treatment was assessed based on the indicators IPSS, QoL, Qmax, Vpr. and PVR. These parameters were determined before surgery and in 1, 3 and 6 months after surgery (Table 3.3.5).

As can be seen from the table 3.3.5. we observed all 50 patients for 6 months. In 46 (92.0%) patients the result of the intervention was assessed as effective. In the long-term postoperative period, 4 (8.0%) developed fibrous-sclerotic changes in the posterior urethra (2 patients) and in the neck of the bladder (2 patients), with the development of BOO, which required additional surgical interventions.

Summary

Transurethral resection of the prostate turned out to be a relatively less traumatic method of surgical treatment for patients with BPH. Frequency of intraoperative bleeding was 1 (2.0%), intraoperative blood loss was minimal and averaged 54.2±9.5 ml per patient. Rehabilitation period was shorter and the postoperative hospital stay was 3.3±0.2 days.

Systematization of postoperative complications according to the adapted Clavien-Dindo classification demonstrated the features of TURP postoperative period and revealed positive and negative aspects of this technique, which remained unnoticed during the usual assessment of interventions. At the same time, having an initial risk of intervention according to ASA II grade in 64% and III grade in 36% of patients, frequency of hemotransfusion was 2 (4.0%), frequency of infectious and

inflammatory complications (urinary tract only) was 4 (8.0%), total frequency of complications requiring additional invasive interventions in the postoperative period was 8 (16.0%), and the treatment efficiency was 92.0%. The main negative side of this method was the presence of long-term complications in the form of fibrosclerotic changes that occurred in the urethra or in the bladder neck, requiring repeated reconstructive surgical interventions due to newly developed BOO.

3.4. The nature, frequency and causes of intra- and postoperative complications of transurethral holmium laser enucleation of the prostate, taking into account volume of the prostate, risk of intervention according to ASA and systematization of complications

Analysis of the results of a clinical examination in III rd group patients was performed in accordance with the standard for examination of patients with BPH. The average age of patients was 65.0 ± 1.1 years, the average volume of the prostate gland was $71.3 \pm 3.6 \text{ cm}^3$. Analysis of scores obtained from IPSS questionnaire, quality of life score, assessment of urination parameters and laboratory test data before HoLEP showed the following picture, Table 3.4.1.

Table 3.4.1

Initial data of patients of group III (HoLEP), n= 40

Indicators	HoLEP
Age	65.0±1.2
BMI (kg/m ²)	27.98±0.8
Prostate volume	91.0±3.8
IPSS	24.7±0.6
QoL	4.5±0.1
Qmax (ml/s)	10.7±1.1
Qaver (ml/s)	2.9±0.4
Vres (ml)	77.2±15.8
Qmax (ml/s) art.	20.1±2.8
Qaver (ml/s) art.	4.4±0.5
Blood Hb (g/l)	141.5±1.95
Creatinine (µmol/l)	97.6±3.1
Urea (mmol/l)	7.3±0.3

Table 3.4.2.

Distribution of patients according to ASA anesthesia risk level in the HoLEP group

ASA grade	HoLEP (n=40) n (%)
I grade	1 (2.5)
II grade	2 (5)
III grade	37 (92.5)
IV grade	-
V grade	-

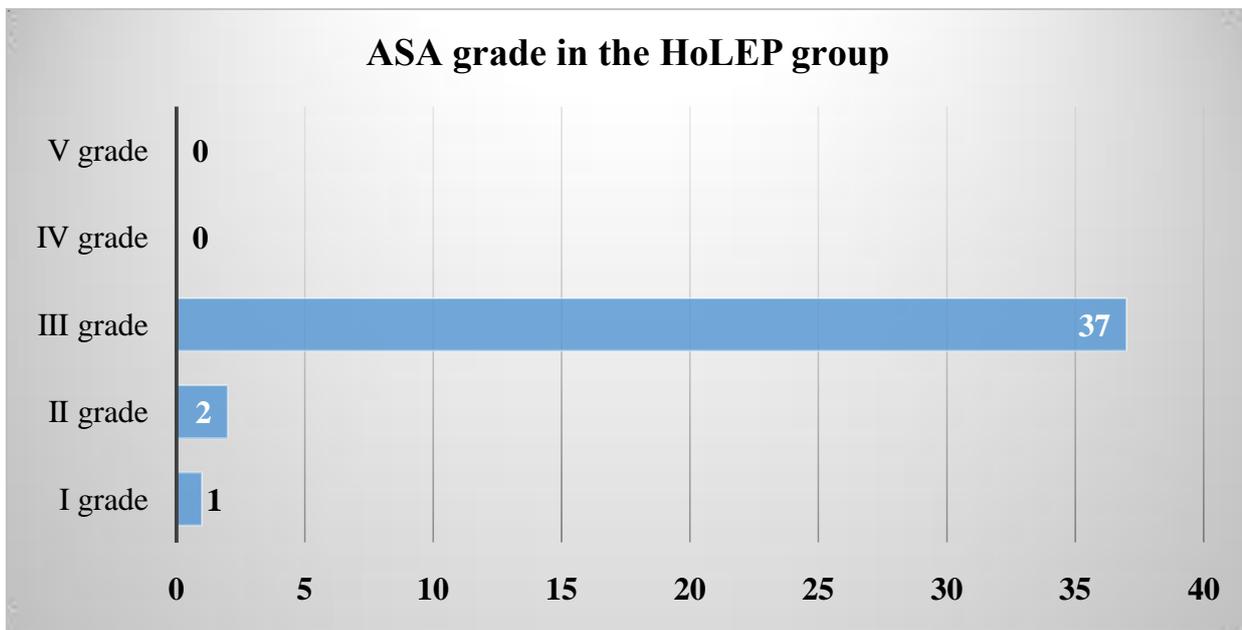


Fig. 3.5. Distribution of patients in the HoLEP group by ASA grade

According to the preoperative examination by the anesthesiologist, the patients were assigned anesthesia risk levels according to the ASA. 1 (2.5) patient had a risk of 1 grade, 2 (5%) patients - 2 grade risk, the vast majority - 37 (92.5%) patients had 3 grade risk, table. 3.4.2 and Figure 3.5.

It should be noted that the method HoLEP is the result of the implementation stage of this methodology for the first time in the Republican Specialized Scientific and Practical Medical Center of Urology. Analysis of the surgical results showed that the HoLEP operation time with morcellation of adenomatous nodes was 136.5 ± 7.0 minutes, with an average volume of removed adenomatous tissue of 73.5 ± 3.3 g. the average intraoperative blood loss was 275.5 ± 35.5 ml

(Table 3.4.3.). As can be seen from Table 3.4.3, due to the peculiarities of the minimally invasive HoLEP operation with intraoperative morcellation of enucleated adenomatous tissue in the bladder, the duration of the intervention increased to 136.5 ± 7.0 minutes, resulting in the incidence of intraoperative bleeding being 3 (7.5 %), the volume of blood loss increased and on average per patient was 275.5 ± 35.5 ml. Other indicators of the postoperative period in the form of the presence of a urethral catheter and cystostomy drainage turned out to be acceptable 2.2 ± 0.1 days and 3.2 ± 0.3 days, respectively.

Table 3.4.3.

Intra- and postoperative parameters of III group patients (HoLEP), n= 40

Duration of operation + morcellation of adenoma in the bladder (min), M±m	136.5 ± 7.0
Volume of tissue removed (g), M±m	73.5 ± 3.3
Frequency of intraoperative bleeding of 700 ml or more (%)	3 (7.5%)
Intraoperative blood loss (ml), M±m	275.5 ± 35.5
Duration of hematuria in the postoperative period (days), M±m	1.2 ± 0.08
Duration of the urethral catheter stay after intervention (days), M±m	2.2 ± 0.1
Duration of cystostomy after intervention (days), M±m	3.2 ± 0.3
Hospital stay after intervention in intensive care (days), M±m	0.3 ± 0.08
Hospital stay after surgery (days), M±m	3.8 ± 0.2

Analysis of the postoperative period of group III patients, the frequency and severity of complications according to the criteria for normal and complicated course of the postoperative period revealed 28 (70%) complications in 20 patients (50%).

We registered 8 (28.6%) cases out of 28 to be grade I complications and included:

Acute urinary retention (failed TWOC)	2
One-day fever above 38°C or febrile fever ($37.0\text{-}38^{\circ}\text{C}$) for more than 2 days, requiring antipyretics	6

We registered 16 (57.1%) cases out of 28 to be grade II complications and included:

Intense blood staining of urine,	3
----------------------------------	---

hypovolemia due to bleeding, requiring hemostatics and/or additional infusion therapy	
Bleeding requiring blood transfusion	1
Difficulty urinating, requiring additional conservative therapy with alpha-blockers and anti-inflammatory drugs	2
Need for analgesics for more than 72 hours after surgery	2
Exacerbation of an infectious-inflammatory process in the urinary tract	8
<ul style="list-style-type: none"> • acute prostatitis 	1
<ul style="list-style-type: none"> • acute urethritis 	7

We registered 3 (10.7%) cases out of 28 to be grade IIIa complications:

Repeated AUR or difficulty urinating requiring urethroscopy	2
Gastroduodenal bleeding requiring endoscopic hemostasis	1

Grade IIIb complication was registered in 1 (3.6%) case:

Urinary bladder tamponade, requiring cystoscopy and bladder blood clot evacuation under spinal anesthesia	1
---	---

Complications of IVa, IVb and V degrees were not registered.

Table 3.4.4. and Fig. 3.6 reflect general distribution of HoLEP surgical complications systematization. Among 40 patients who have undergone HoLEP in the postoperative period, only 28 (70%) complications were observed in 20 patients (50%). There were 24 (85.7%) complications of I and II degree, requiring conservative management. 3 (10.7%) complications of IIIa degree had required invasive interventions under local anesthesia, and in 1 (3.6%)

complication of IIIb invasive intervention was performed under general anesthesia.

Table 3.4.4.
Systematization of postoperative complications in HoLEP according to the adapted Clavien-Dindo classification, (n=28)

I grade	II grade	IIIa grade	IIIb grade	IVa grade	IVb grade	V grade
8 (28.6%)	16 (57.1%)	3 (10.7%)	1 (3.6%)	0	0	0

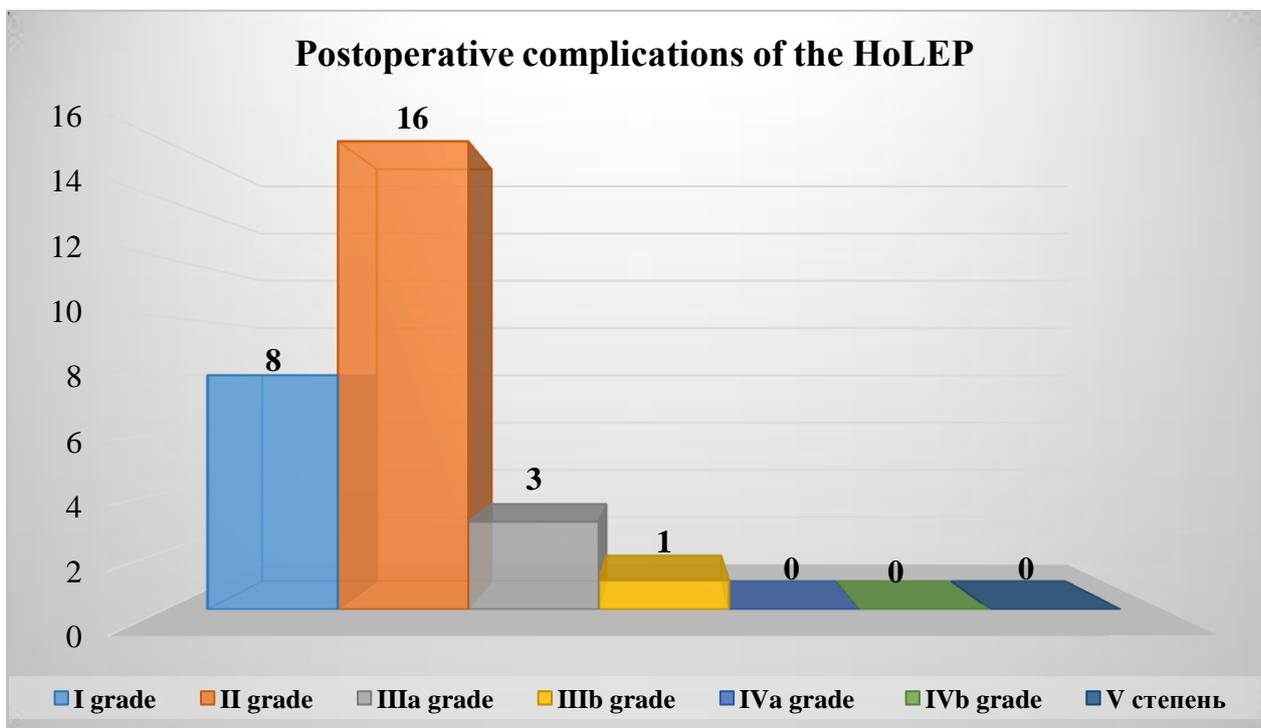


Fig. 3.6. Distribution of postoperative HoLEP complications depending on severity

Analysis of results and effectiveness of HoLEP was also assessed based on IPSS, QoL, Qmax, Vpr. (prostate volume) and PVR (residual urine volume). All of the above parameters, as in the first two groups of patients, were determined before surgery, as well as at 1 month, 3 months and 6 months after surgery (Table 3.4.5).

Table 3.4.5.

Efficacy of treatment in patients with BPH who underwent HoLEP

No.	Index	Before surgery	1 month after surgery	3 months after surgery	6 months after surgery
1.	IPSS	24.7±0.6	7.6±0.2*	6.8±0.2*	5.9±0.2*
2.	QoL	4.5±0.1	3.2±0.06*	2.3±0.08*	2.0±0.06*
3.	Qmax	10.7±1.1	18.9±0.3*	20.05±0.4*	20.9±0.3*
4.	Vpr.	91.0±3.8	28.1±1.0*	26.2±1.0*	25.4±0.9*
5.	PVR	77.2±15.8	26.4±3.1*	21.0±3.3*	17.1±2.3*

**p<0.05 compared with the preoperative period*

According to the table 3.4.5., all 40 patients has been followed-up after HoLEP for 6 months. In all 40 (100%) patients the result of the intervention was assessed as effective. There were no lethal outcomes. Not a single patient has developed fibrosclerotic changes in the urethra and bladder neck in the long-term postoperative period.

Summary

A new method - transurethral holmium laser enucleation of the prostate (HoLEP) even at the stage of its implementation turned out to be a low-traumatic and highly effective method of surgical treatment in patients with BPH. At the same time, due to technical difficulties at the stage of introducing a new technique of transurethral intervention, the incidence of intraoperative bleeding was 3 (7.5%) cases, only 1 of them required blood transfusion in the early postoperative period. Intraoperative blood loss averaged 275.5±35.5 ml per patient, postoperative hospital stay was 3.8±0.2 days.

Systematization of postoperative complications according to the adapted Clavien-Dindo classification, in turn, demonstrated the features of the postoperative period in HoLEP also revealed those complications that would have gone unnoticed and/or unaccounted for in the usual assessment of complications. At the same time, patients who have undergone HoLEP, having an initial risk of intervention according to ASA grade I in 2.5%, grade II in 5% and grade III in 92.5% (the vast majority had a high risk), achieved high efficiency. Frequency of blood transfusion was 1 (2.5%), the frequency of infectious and inflammatory complications (urinary tract only) was 8 (20.0%), the total frequency of

complications requiring repeated invasive interventions in the postoperative period was 4 (10.0%), there were no long-term complications leading again to the development of IVO with the need for reconstructive interventions, and the effectiveness of the operation was 100.0%.

3.5. Comparative assessment of the effectiveness of OPA, TURP and HoLEP, taking into account the results of systematization of postoperative complications

Comparative assessment of the results of three different methods of BPH surgical treatment based on the data obtained while systematizing of complications, carried out according to adapted Clavien-Dindo classification of postoperative surgical complications.

Table 3.5.1.
Comparative assessment of initial parameters of I, II, III groups of patients

Groups	Prostate volume (before surgery)	IPSS	QoL	Qmax ml/sec	PVR (ml)
I n=60	90.4±3.1*	28.3±0.3**	4.75±0.1	6.6±0.3***	246.2±28.9** *
II n=50	72.7±3.0	25.1±0.5	4.6±0.1	6.9±0.3	203.3±37.7
III n=40	91.0±3.8.	24.7±0.6	4.5±0.1	10.7±1.1	77.2±15.8

* $p < 0.05$ between I and II, between II and III groups.

** $p < 0.05$ between I and II, between I and III groups.

*** $p < 0.05$ between I and III, between II and III groups.

A comparative assessment of main initial urination parameters, as well as the volume of the prostate in patients before surgery, presented in the table. 3.5.1.

As can be seen from Table 3.5.1, in patients of the first group the average volume of the prostate gland was greater than in patients of the second group, while the prostate volume of the first and third groups did not differ. IPSS scores and volume of residual urine were

also significantly higher in patients of first group. The quality-of-life index in patients before surgery due to BPH was identically low in all patients of all groups, which served as the main indication for surgical treatment.

Table 3.5.2.

Comparative assessment of complications and various indicators of patients of all three groups

Type of complications	Groups of patients and frequency of complications		
	<i>OPA (n=60)</i>	<i>TURP (n=50)</i>	<i>HoLEP (n=40)</i>
¹ Blood transfusion, n (%)	4 (6.7)	2 (4.0)	1 (2.5)
² Duration of draining by urethral catheter after surgery, (days), M±m	8.4±0.3	2.9±0.1	2.2±0.1
³ Duration of cystostomy drainage after surgery, (days), M±m	4.6±0.3	2.9±0.5	3.2±0.3
⁴ Infectious and inflammatory complications, n (%)	6 (10)	4 (8.0)	8 (20.0)
⁵ Additional invasive interventions in the early postoperative period, n (%)	9 (15.0)	4 (8.0)	4 (10.0)
⁶ Additional reconstructive interventions due to late complications, n (%)	3 (5.0)	4 (8.0)	-
⁷ Postoperative hospital stay (day), M±m	8.6±0.3	3.3±0.2	3.8±0.2
⁸ Lethal outcomes, n (%)	2 (3.3)	-	-
⁹ Effectiveness, n (%)	91.7	92.0	100.0

¹*p* >0.05 between all groups;

²*p* <0.01 between groups I and II, III, *p* <0.05 between groups II and III;

³*p* <0.05 between groups I and II, III, *p* >0.05 between groups II and III;

⁴*p* > 0.05 between groups I and II, III, *p* < 0.05 between groups II and III;

⁵*p* >0.05 between all groups;

⁶*p* >0.05 between groups I and II;

⁷*p* >0.05 between groups I and II, III, *p* >0.05 between groups II and III;

⁹*p* >0.05 between groups I and II; *p* <0.05 between I and III, between II and III groups;

⁵*p* >0.05 between all groups.

Next, a comparative assessment of frequency and severity of complications was conducted. Postoperative bleeding was observed in only 37 (24.7%) patients, in 7 (4.7%) of them hemotransfusion was

performed. This parameter after OPA was 4 (6.7%), after TURP - 2 (4.0%) and after HoLEP blood transfusion was performed in 1 (2.5%) case. Thus, the incidence of the most severe complication, bleeding requiring blood transfusion, was higher after OPA. After TURP and HoLEP, the data were comparable, but the indicator between the groups was not statistically significantly different ($p>0.05$). In table 3.5.2. the main parameters of the intra- and postoperative period that influence the outcomes of patients' treatment are presented in a comparative aspect.

A detailed analysis of complications showed that additional interventions in the early postoperative period, although the data were not statistically different, were more often performed after OPA; the frequency was approximately the same after TURP and HoLEP. It should be noted that after HoLEP, additional interventions were relatively less invasive, such as urethrocystoscopy in 2 cases, evacuation of blood clots from the urinary bladder in 1 case, gastroduodenoscopy with vessel coagulation in 1 case.

Also, only 7 late complications were identified, characterizing the trauma of interventions, which were observed only after OPA and TURP: 2 (4.0%) - stricture of the posterior urethra and 2 (4.0%) cases of urinary bladder neck sclerosis developed after TURP; 2 (3.3%) – urethral strictures and 1 (1.7%) urinary bladder neck sclerosis after OPA. After HoLEP, we did not observe any late complications requiring reconstructive plastic surgery.

Lethal outcomes were observed only after OPA. Postoperative hospital stay was significantly longer after OPA than in other groups of patients. The effectiveness of treatment was 100% only after HoLEP due to the absence of deaths and late complications leading to the newly developed BOO.

Comparison of the results of systematization of postoperative complications showed the following picture, table. 3.5.3.

Systematization of postoperative complications according to the adapted Clavien-Dindo classification showed that the frequency and severity of complications are greater after OPA. The results of TURP and HoLEP were comparable, but HoLEP was more effective.

Table 3.5.3.

Comparative assessment of frequency and severity of postoperative complications after OPA, TURP and HoLEP due to adapted Clavien-Dindo classification system

Degree	Groups of patients and frequency of complications		
	OPA (n=60) n (%)	TURP (n=50) n (%)	HoLEP (n=40) n (%)
I	89 (148.3)	16 (32.0)	8 (20.0)
II	48 (80.0)	17 (34.0)	16 (40.0)
III	12 (20.0)	8 (16.0)	4 (10.0)
IIIa	9 (15.0)	1 (2.0)	3 (7.5)
IIIb	3 (5.0)	7 (14.0)	1 (2.5)
IV	3 (5.0)	-	-
IVa	3 (5.0)	-	-
IVb	-	-	-
V	2 (3.3)	-	-
Total complications	154 (256.6)*	41 (82.0)**	28 (70.0)

The % of complications was calculated in relation to the number of interventions performed.

**p < 0.01 between I and II, between I and III groups.*

*** p >0.05 between II and III groups.*

For clarity and completeness of the comparative assessment of various methods of surgical treatment of BPH, it is necessary to compare effectiveness of treatment taking into account an existing initial risk of intervention according to the objective status of patients, determined due to ASA classification, Table. 3.5.4.

Of 150 patients, 82 had grade II risk according to ASA, 67 had grade III risk, and only 1 had grade I. As can be seen from the table, the somatic status of patients in the first group in terms of severity was significantly lower (2.2 ± 0.05) compared to patients in the second and third groups. The vast majority of patients in III group, who had undergone HoLEP, had a high risk of intervention compared to patients in other groups, while the effectiveness of treatment in this group was 100%.

Table 3.5.4.

Distribution of patients according to ASA anesthesia risk level

ASA grade	Method of surgical treatment of BPH			Total n (%)
	OPA (n=60) n (%)	TURP (n=50) n (%)	HoLEP (n=40) n (%)	
I	-	-	1 (2.5)	1 (0.7)
II	48 (80)	32 (64)	2 (5)	82 (54.7)
III	12 (20)	18 (36)	37 (92.5)	67 (44.7)
IV	-	-	-	-
V	-	-	-	-
Average value	2.2±0.05	2.4±0.07	2.9±0.06	2.4±0.04

p < 0.05 between groups I and II;
p < 0.01 between groups I and III;
p < 0.05 between groups II and III.

Summary

Thus, despite the fact that the smallest number of patients with grade III risk according to ASA were operated on in a traditional open manner, in this group there were significantly more severe complications, the elimination of which required additional invasive interventions, remaining of patients in the intensive care unit and development of cardiovascular system (CVS) complications in 2 patients, leading to their death.

TURP and HoLEP turned out to be minimally invasive, with low frequency and severity of complications. The complications themselves are milder, patient rehabilitation takes less time and the cost-effectiveness is higher. Consequently, according to the invasiveness of the intervention, the frequency and severity of the observed complications, these methods were arranged in the following order: OPA, TURP, HoLEP; according to the effectiveness of treatment in the following order: HoLEP, TURP, OPA.

CONCLUSION

Issues of management of patients with benign prostatic hyperplasia have occupied urologists since the emergence of knowledge about this disease. Despite the fact that over the past two decades, qualitative breakthroughs have been made both in diagnosis and in treatment (conservative and surgical) of patients with prostatic hyperplasia, this problem remains relevant to this day. The reason for this is the development of science and the development of new medical equipment, which contributed to the emergence of new medications with a more selective effect for conservative therapy; new minimally invasive endoscopic technologies aimed at reducing the invasiveness and trauma of interventions to remove adenomatous nodes. Consequently, researchers are working to study the advantages and disadvantages of new methods of prostate hyperplasia management in search of a solution to the issue of optimizing treatment tactics for patients with BPH.

Literature data suggest that in the vast majority of cases, patients with BPH seek specialized urological care in old age, when there are serious concomitant diseases that increase the risk of complications during surgery and in the postoperative period [94,171]. According to the literature, the frequency of postoperative mortality in elderly patients with BPH associated with therapeutic complications (48.6%) is significantly higher than with surgical complications (16.6%) [94]. It is also known that the degree of surgical risk, frequency and severity of non-urological complications primarily depend on concomitant diseases of the patient's cardiovascular system [172,173]. In most countries, including Uzbekistan, a classification of the degree of risk of general anesthesia, approved by the American Society of Anesthesiologists (ASA), based on the gradation of the physical condition of patients, has been adopted. The classification involves dividing patients into five categories when performing planned surgical interventions. Patients who are currently unable to undergo traditional open surgery for BPH may be classified into ASA categories III (severe disease with impairment of function) or IV (severe disease that, with or without surgery, threatens the patient's life).

Currently, in patients with BPH with severe concomitant diseases, minimally invasive surgical interventions can be considered alternative

treatment methods to traditional open surgical interventions, if there are absolute indications for surgical treatment [174].

Considering that, patients with the same disease - BPH - are operated on with various radical surgical methods indicates that the issue regarding the tactics of surgical treatment of this nosology has not been fully resolved.

For this reason it was very important to improve results of BPH surgical treatment by assessing effectiveness and safety of three most popular radical surgical treatment methods. To objectively assess the quality of any method of surgical treatment, it is necessary to study several indicators:

- 1) traumatism of the intervention;
- 2) volume of intervention and observed intra- and postoperative complications, due to their frequency and severity;
- 3) terms of rehabilitation of patients after the intervention;
- 4) the effectiveness of treatment.

In this direction the key point was adaptation of the Clavien-Dindo classification of surgical complications to the assessment of postoperative complications of BPH surgical treatment, because many years of using this classification by specialists have shown that its formulaic use leads to errors in assessing complications. The most common errors were made in the assessment of mild complications, as well as in distinguishing the severity of complications requiring their conservative elimination [8,23,63,79,102]. This, in turn, led to a lack of objectivity in the assessment of complications, which is extremely undesirable, since the classification was originally developed for an objective assessment and comparison of treatment results between different specialists and different centers. Consequently, all specialists must work in accordance with a single classification system and a single standard.

Analysis of literature data on the surgical treatment of BPH and systematization of postoperative complications showed that in the international urological community there are no criteria for an uncomplicated postoperative period. The urological community has not yet come to a consensus on what postoperative course and phenomenon in a patient during radical surgical removal of BPH should be considered normal and when any symptoms and/or changes appear to indicate the onset of a complicated postoperative course.

Finding an answer to this question turned out to be a difficult task, because it required the study of many years of experience in the postoperative management of such patients and the identification of those basic criteria necessary to determine the course of the disease. The key criteria were the intensity of urine staining with blood and its duration, the rise in body temperature and its duration, the duration of the intraoperatively installed urethral hemostatic catheter, the duration of the cystostomy drainage, restoration of urination, urinary retention or incontinence.

It was important not only to highlight the criteria for complications of surgical treatment of BPH, but also to clearly distinguish the uncomplicated postoperative period from the complicated one. In the postoperative period during surgical removal of BPH, almost all patients experience hematuria to varying degrees during the first few days due to catheters installed in the lower urinary tract. There is an increase in body temperature of varying intensity and duration, pain and false urges associated with the intervention and the presence of a urethral hemostatic catheter, and concomitant pathology. But what degree of hematuria is considered normal, and where does the complication begin? What kind of hyperthermia and for what duration is considered normal? Postoperative infectious and inflammatory complication associated with the presence of a urethral catheter? Urinary incontinence in the postoperative period, is this a normal temporary phenomenon after adenomectomy? If so, how long does it take for continence to return? These questions are very important in terms of objective assessment of complications. Authors who used Clavien-Dindo classification system for assessment of BPH surgical treatment results, in their studies did not pay attention to these issues and did not find any shortcomings in the classification itself [8,23,63,79,102].

It may be thought that it is necessary to develop separate criteria of the normal course of postoperative period for OPA and for transurethral endoscopic techniques, since open surgery is more traumatic and has special features of postoperative management. Such a division may cause unjustified cumbersomeness of the classification system and cause confusion in the issues of classification of complications by different specialists. Classification system of postoperative complications in BPH surgery, as a special system for assessing the quality of intervention,

should be uniform for all surgical treatment modalities, regardless of the degree of invasiveness and volume of intervention.

By defining the criteria for an uncomplicated course of the postoperative period, became possible to identify the border where the complication begins and, in our work, answered all the listed questions. Thanks to the creation of criteria of the normal course of postoperative period in surgical methods of BPH treatment, Clavien-Dindo classification of surgical complications was adapted for an objective assessment of complications of surgical removal of prostate adenoma, without violating its logic. Having systematized complications by developing criteria for uncomplicated and complicated course of surgical removal of BPH, it became possible not only to objectively evaluate complications, but also to identify those that went unnoticed during conventional analysis. For example, the presence of a urethral hemostatic catheter for more than 72 hours, or cystostomy drainage for more than 5 days, urinary incontinence for more than 1 month. It has been proven, through systematization, that such an excessively long stay of a catheter - a foreign body (minor complication) plays a significant role in the occurrence of other complications.

Further, after adapting the Clavien-Dindo classification to the assessment of postoperative complications of BPH surgical treatment, an opportunity of objectively assessment of effectiveness and quality of various surgical methods for BPH removal has arisen.

Frequency and severity of intra- and postoperative complications of open adenomectomy was investigated and systematization of postoperative complications according to adapted classification was performed. OPA turned out to be a rather traumatic method of surgical treatment of patients with BPH. At the same time, number of patients with intense bleeding during surgery was 5 (8.3%), as a result, the average intraoperative blood loss per patient in this group of patients was 287.5 ± 16.7 ml. Systematization of postoperative complications according to the adapted Clavien-Dindo classification demonstrated the features of postoperative period after OPA, and it also revealed those shortcomings of OPA that went unnoticed during usual assessment of interventions. Having analyzed the initial risks of intervention according to ASA, a very important indicator demonstrating the injury and severity of the intervention was identified. With the initial risk of intervention according to ASA grade II in 80% and grade III in 20% of patients,

frequency of blood transfusion was 4 (6.7%), total frequency of infectious and inflammatory complications (urinary tract and other organs) was 10 (16.7 %), total frequency of complications requiring repeated invasive and reconstructive surgical interventions in the postoperative period was 12 (7.8%), mortality from cardiovascular system complications due to concomitant diseases was 2 (3.3%), postoperative hospital stay was $8,6\pm 0.3$ days. Effectiveness of treatment of patients was low both due to long-term complications and mortality and amounted to 91.7%.

In the same way, results of transurethral resection of BPH were examined. It was found that TURP turned out to be a relatively low-traumatic method of surgical treatment of patients with BPH.

Frequency of intraoperative bleeding was 1 (2.0%), intraoperative blood loss was minimal and averaged 54.2 ± 9.5 ml per patient, rehabilitation of patients was shorter, patients became more active earlier in the postoperative period. Systematization of postoperative complications taking into account the criteria of normal postoperative period due to adapted Clavien-Dindo classification system, in turn, demonstrated the features of the postoperative period during transurethral resection of prostate hyperplasia and revealed the positive and negative features of this technique, which also remained unnoticed without systematization of complications.

Systematization of complications according to strict criteria for their detection demonstrates a greater number of complications, compared with data in which the registration of complications is performed without systematization, or without using such criteria.

Rassweiler J. et al. showed that over time, improvement of technological and instrumental support for performing TURP led to a decrease in the need for blood transfusions to 0.4% against the previous 7.1% (our data - 4%), TUR syndrome is now almost never encountered (previously 1.1%) (our data - 0), obstruction by clots - 2% (previously 5%) (our data - 6%), UTI - 1.7% (8.2%) (our data - 8%). The frequency of acute urinary retention (3% against the previous 9%) (our data - 4%). Late complications include urethral strictures (2.2-9.8%) (our data - 4%), bladder neck sclerosis (0.3-9.2%) (our data - 4%). Mortality after TURP is 0.0-0.025% (our data - 0), postoperative hospital stay was only 3.3 ± 0.2 days [105].

Moreover, taking into account the initial risk of intervention according to ASA grade II in 64% and grade III in 36% of patients, the effectiveness of treatment of patients due to the presence of late long-term complications in the form of urethral stricture and sclerosis of the bladder neck, which required repeated surgical interventions, was 92.0%. It is necessary to be objective and note that the main negative side of this method, as well as with OPA, was the presence of late (long-term) complications in the form of fibrosclerotic changes in the urethra and the bladder neck area, which required reconstructive surgical interventions due to newly developed BOO.

It was necessary to evaluate a new method of BPH surgical treatment - holmium laser enucleation of the prostate (HoLEP). This technique has received recognition and good reviews from numerous foreign specialists who have previously implemented it in their centers. In Uzbekistan, HoLEP began to be implemented in the clinic of the Republican Specialized Scientific and Practical Medical Center of Urology and we received and analyzed the first results of the new method. At the same time, it was clear that when new surgical treatment methods are introduced, before they become routine, the frequency of complications is always higher, because there is a period of mastering the new technology [175,176] and comparison of their results with the results of other clinics may not always be correct.

So, the new method HoLEP, even at the implementation stage, turned out to be a low-traumatic and highly effective method of surgical treatment of patients with BPH. At the same time, due to technical difficulties at the implementation stage, the frequency of unexpected intense intraoperative bleeding was 3 (7.5%) cases, of which only 1 patient needed blood replacement in the early postoperative period. As a result, intraoperative blood loss was greater and averaged 275.5 ± 35.5 ml.

Systematization of postoperative complications according to adapted Clavien-Dindo classification has also demonstrated the features of the postoperative period after HoLEP and revealed those complications that would have remained unnoticed and/or unaccounted for without their systematization. Analysis of the results of the intervention, based on risk according to ASA, showed that 2.5% of patients had I grade risk, 5% had II grade risk, and 92.5%, i.e. the vast majority of patients have III grade risk according to ASA. Even with a

high risk of anesthesia, HoLEP has been shown to be highly effective. Frequency of blood transfusions was 1 (2.5%), frequency of infectious and inflammatory complications that were observed only in the urinary tract was 8 (20.0%), total frequency of complications requiring repeated invasive interventions in the postoperative period was 4 (10.0. %), postoperative hospital stay was 3.8 ± 0.2 days. Due to the absence of long-term complications that could lead to the development of IVO with the need for repeated reconstructive interventions, effectiveness of this surgical treatment method was 100.0%.

Thus, having systematized the complications and studied the effectiveness of three different surgical methods for BPH management, we conducted a comparative assessment to determine the most effective surgical method among the selected methods, taking into account the economic side of the issue.

It is also very important to analyse effectiveness of BPH surgical treatment and take into account the initial risk of anesthesia according to the ASA classification. We have not seen such an analysis in the treatment of BPH in the literature. The smallest number of patients with ASA risk III were operated on in a traditional open manner, but despite this, in this group significantly more severe complications were identified, elimination of which required additional invasive interventions, patients in the intensive care unit and complications from the cardiovascular system led to the death of 2 patients.

A meta-analysis by Ahyai S.A. et al., which compared TURP and HoLEP, demonstrated the following: frequency of blood transfusions after TURP was 2.2%, after HoLEP there was no need for blood transfusion (our rates were 4% and 2.5%, respectively); duration of catheterization after TURP was 43.4 - 57.8 hours, and after HoLEP it varied from 17.7 to 31 hours (in our patients, duration of catheterization was less than 3 days for both methods); duration of hospitalization after laser enucleation averaged 2-3 days, and after TURP - 3-6 days, in our patients the average hospital stay was 3.8 ± 0.2 days after HoLEP and 3.3 ± 0.2 days after TURP [58].

Minimally invasive methods of BPH surgical treatment - TURP and HoLEP actually turned out to be less traumatic - frequency and severity of complications after these methods were lower, they were easier to tolerate by patients, and rehabilitation of patients occurred earlier, despite the fact that the goal was also radical removal of prostate

hyperplasia tissue. Consequently, the cost-effectiveness of the latter methods was higher than that of OPA.

As a result of comparison of data such as frequency of intra- and postoperative complications, the results of their systematization, the duration of patient stay in the hospital and the rehabilitation period, the final effectiveness of three different methods of surgical treatment of BPH, the indicated treatment methods according to traumaticity were arranged in the following order: OPA, TURP, HoLEP, and according to the effectiveness of treatment of patients in the following order: HoLEP, TURP, OPA.

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