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WAYS TO REDUCE COMPLICATIONS DURING OPEN ADENOMECTOMY IN PATIENTS WITH BPH USING MODIFIED REMOVABLE SUTURES

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Abstract. Ways to reduce complications during open adenomectomy in patients with BPH using modified removable sutures. Botalaev B., Usupbaev A., Abdykalykov M., Zhumagaziev T., Mailubashev M. *The study was aimed at evaluating the effectiveness of using a modified removable purse-string suture with polyurethane tubing to reduce complications after transvesical adenomectomy in patients with benign prostatic hyperplasia. A total of 60 patients participated in the study. They were distributed into two groups: 30 patients in the main group, where the improved method using a polyurethane tube was used, and 30 patients in the control group, where the standard technique without removable suture was used. The comparison showed that in the main group, the average volume of blood loss in the first 48 hours was 240 [200-280] ml, which was significantly less than in the control group, where it reached 385 [320-450] ml ($p<0.05$). Furthermore, in patients of the main group, the haemoglobin level on the first day after surgery was higher – 112.3 [103.9-120.7] g/l compared to 104.5 [96.9-112.1] g/l in the control group ($p<0.05$). This indicated better control of blood loss. The incidence of complications such as bleeding and inflammation was lower in the main group, 6% versus 20% in the control group ($p<0.05$). Additionally, the level of C-reactive protein on the third day after surgery in the main group was 12.3 [10.1-14.5] mg/l, while in the control group, it was significantly higher – 17.6 [14.1-21.1] mg/l ($p<0.05$). Thus, the use of removable purse-string suture with polyurethane tube demonstrated its effectiveness in reducing blood loss and complication rate, providing better recovery after surgery in patients with benign prostatic hyperplasia. The findings demonstrate that the use of a modified removable purse-string suture with polyurethane tubing effectively reduces blood loss, enhances haemostasis, and lowers the incidence of postoperative complications in patients undergoing transvesical adenomectomy for benign prostatic hyperplasia. Additionally, this technique contributes to a shorter recovery period and improved haemoglobin levels, indicating better overall postoperative outcomes.*

Реферат. Шляхи зменшення ускладнень при відкритій аденомектомії у хворих на доброякісну гіперплазію передміхурової залози з використанням модифікованих знімних швів. Боталаєв Б., Усупбаєв А., Абдикаликов М., Жумагазієв Т., Майлубашев М. *Мета дослідження – оцінити ефективність використання модифікованого знімного кисетного шва з поліуретановою трубкою для зменшення ускладнень після черезміхурової аденомектомії у хворих на доброякісну гіперплазію передміхурової залози. Усього в дослідженні взяли участь 60 пацієнтів. Їх було розподілено на дві групи: 30 пацієнтів в основній групі, де застосовувався вдосконалений метод із застосуванням поліуретанової трубки, і 30 пацієнтів у контрольній групі, де застосовували стандартну методику без знімного шва. Порівняння показало, що в основній групі середній об'єм крововтрати за перші 48 годин становив 240 [200-280] мл, що достовірно менше, ніж у контрольній групі, де він досягав 385 [320-450] мл ($p<0,05$). Крім того, у пацієнтів основної групи рівень гемоглобіну в першу добу після операції був вищим – 112,3 [103,9-120,7] г/л порівняно з 104,5 [96,9-112,1] г/л у контрольній групі ($p<0,05$). Це свідчить про кращий контроль крововтрати. Частота таких ускладнень, як кровотечі та запалення, була нижчою в основній групі, 6% проти 20% у контрольній групі ($p<0,05$). Крім того, рівень С-реактивного білка на третю добу після операції в основній групі становив 12,3 [10,1-14,5] мг/л, тоді як у групі контролю він був достовірно вищим – 17,6 [14,1-21,1] мг/л ($p<0,05$). Таким чином, використання знімного*

кисетного шва з поліуретановою трубкою продемонструвало його ефективність у зменшенні крововтрати та частоти ускладнень, забезпечуючи краще відновлення після операції в пацієнтів з доброякісною гіперплазією передміхурової залози. Отримані дані демонструють, що використання модифікованого знімного кисетного шва з поліуретановою трубкою ефективно зменшує крововтрату, покращує гемостаз і знижує частоту післяопераційних ускладнень у пацієнтів, які перенесли черезміхурову аденомектомію з приводу доброякісної гіперплазії передміхурової залози. Крім того, ця методика сприяє скороченню періоду відновлення та покращенню рівня гемоглобіну, що вказує на кращі загальні післяопераційні результати.

Benign prostatic hyperplasia (BPH) is one of the most common urological diseases among men over 50 years of age. As the disease progresses, surgery becomes one of the most effective treatment options [1]. Despite its effectiveness in treating BPH, transvesical adenomectomy is accompanied by significant risks of complications such as bleeding, inflammatory reactions and other postoperative complications. In recent years, increasing attention has been paid to methods aimed at reducing the incidence of these complications, which is especially important for patients with an increased risk of blood loss. One of the effective methods is the use of modified removable sutures, which can significantly increase the efficiency of surgical treatment and improve its results.

L.F. Pérez Medina et al. [2] examined postoperative complications in BPH patients who had different surgical procedures. The authors provided important insights into the risks associated with various techniques by highlighting the complications and lengths of hospital stays for open transvesical, retropubic, and monopolar endoscopic adenomectomy. This study's significance stems from its comparison of surgical results, which helps to clarify the effectiveness of various approaches and their drawbacks when treating BPH. The perioperative results of retropubic and transvesical open adenomectomy in patients with BPH were compared by A. Baktybek Uulu et al. [3]. Retropubic adenomectomy led to better postoperative recovery, including shorter catheterization durations and improved prostate symptom scores, despite having a higher intraoperative blood loss, according to the study. This study advances the field by providing a comparative analysis of surgical techniques to help choose the best recovery strategy for patients undergoing BPH procedures.

For the treatment of BPH, L.R. Sfredo et al. [4] compared open transvesical and videolaparoscopic prostatectomy procedures. They compared surgical time, blood loss, length of stay, and other postoperative outcomes by looking at the medical records of patients who had transvesical adenectomy at a tertiary hospital. Despite a shorter hospital stay, the researchers discovered that the laparoscopic procedure necessitated a significantly longer surgical duration. This study is pertinent to the current body of research because it compares various surgical techniques and emphasises the trade-offs between recovery time and surgical time, which are critical for assessing and improving BPH treatment plans.

N. Akassimadou et al. [5] looked into the postoperative complications of transvesical prostatic adenomectomy. The study highlighted the need for better postoperative management by identifying common complications like infections and urine leakage. Its thorough examination of complications and the possibility of lowering these risks through better surgical and postoperative care techniques make it pertinent to the current investigation.

J.A. Fariñas Martínez et al. [6] examined the risks of infections and wound dehiscence in relation to adenomectomy complications in older patients. In order to lower postoperative complications, their findings highlighted the significance of preoperative care and suitable surgical techniques. By drawing attention to the difficulties and dangers involved in older patients having BPH surgeries, this study advances the field's understanding of the condition and offers suggestions for improving patient care.

In the urology department of a university hospital, A. Berthe et al. [7] investigated the postoperative complications of transvesical adenomectomy. They discovered that suppuration and urinary tract infections were common, especially in patients with a history of medical disorders. This study is relevant because it emphasises how crucial preoperative screening and postoperative care are to reducing complications, which is essential to enhancing patient outcomes in the setting of the current investigation.

A minimally invasive method for treating large-volume BPH using endoscopic transvesical adenomectomy was presented by W.M.H. van der Sanden et al. [8]. With a minimal invasion approach, the study showed that this technique is safe and offers promising functional outcomes. In line with the objectives of optimising surgical techniques in the treatment of BPH, this study is relevant because it examines novel, minimally invasive surgical techniques that may shorten recovery times and lower complications [9].

The topic of this study is highly relevant in the context of ongoing efforts to improve the surgical treatment of BPH, particularly through the reduction of postoperative complications. As the review of recent literature highlights, traditional surgical procedures like transvesical adenomectomy are associated

with risks such as significant blood loss, infections, and prolonged recovery periods. The aim of the present study was to evaluate the efficacy of modified removable purse-string suture with polyurethane tubing to reduce complications during transvesical adenomectomy in patients with benign prostatic hyperplasia. The objectives of the study included the analysis of the effect of the modified suture on the level of blood loss, the incidence of inflammatory complications, as well as the assessment of the recovery period in patients who underwent surgery using this technique. This reinforces the study's relevance and its potential contribution to enhancing the efficacy and safety of BPH surgeries.

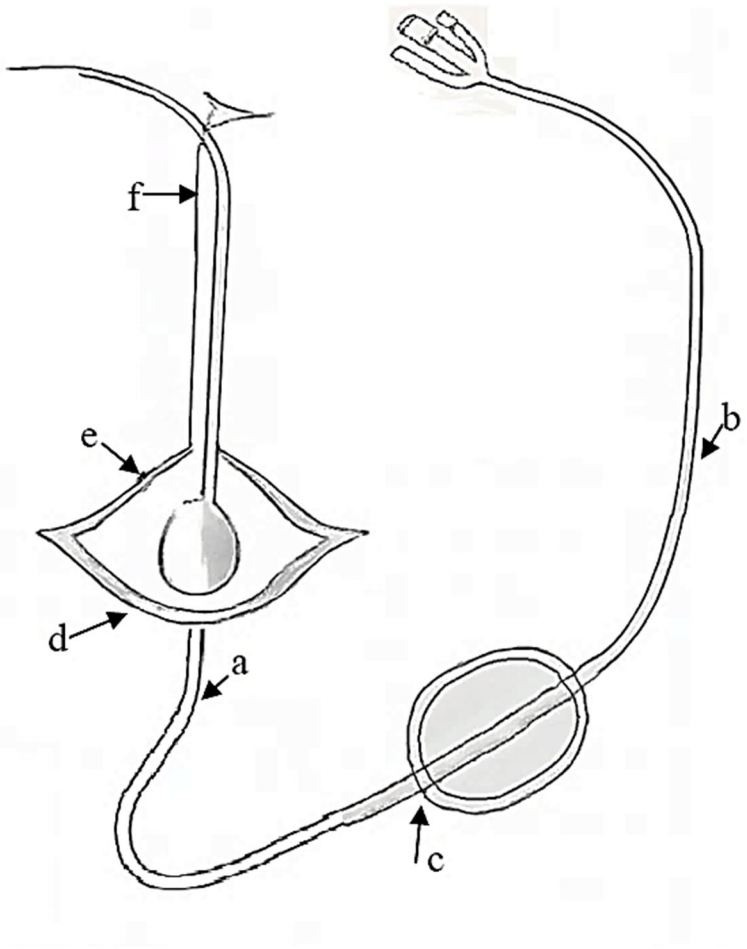
MATERIALS AND METHODS OF RESEARCH

This study was conducted at the Scientific Centre of Urology at the National Research Centre of the Ministry of Health of the Kyrgyz Republic, between January and December 2024. The study included 60 patients diagnosed with benign prostatic hyperplasia who underwent transvesical adenomectomy. The study included individuals over 50 years old diagnosed with BPH, who were slated for open adenomectomy and had given informed consent. Exclusion criteria included patients with significant comorbidities, including cardiovascular or renal diseases, persons with acute infections or prostate cancer, those unable of providing informed permission owing to cognitive impairments, and patients who had already undergone prostate surgery. These criteria were established to guarantee the inclusion of appropriate candidates for the study, reducing any confounding variables and facilitating a concentrated assessment of the improved suture technique's efficacy. It is also important to note that the patients included in this study had significantly enlarged prostates, with prostate volumes considered large enough to warrant open adenomectomy as the surgical intervention of choice. No patients dropped out of the study, all 60 patients completed the study and were included in the analysis. The participants were divided into two groups: main group and control group. The divide was executed through a methodical allocation of patients, guaranteeing an equal distribution in both groups to enable a balanced comparison of outcomes between the two treatment regimens. In the main group, consisting of 30 patients, a modified method of haemostasis using a removable purse-string suture and an additional polyurethane tube was used. In the control group, also including 30 patients, the standard technique of surgery without the use of removable suture was used.

All patients underwent a preliminary comprehensive examination, including clinical and laboratory tests, as well as ultrasound examination of the pelvic organs. The examinations included haemoglobin level estimation, coagulogram to assess blood coagulability and general urinalysis. The surgeries were performed under spinal anaesthesia in sterile conditions of the operating room. Surgical access was performed through an incision of the anterior wall of the bladder. After removal of adenomatous nodules of the prostate gland in the main group, a removable purse-string suture was applied to the prostate bed with subsequent installation of a silicone-latex balloon urethral catheter F18-24 (France) inflated to the volume of 40-45 cm^3. In case of severe postoperative bleeding, the balloon volume was increased up to 60 cm^3, which contributed to additional haemostasis. Simultaneously with the catheter, a polyurethane tube F4-6 (France) was inserted through the urethra into the prostate bed, which was stitched and fixed with sutures to the catheter to ensure reliable tightness (Fig.). This prevented drainage displacement, ensure stable haemostasis, and facilitate the effective removal of fluids from the prostate bed, thereby reducing the risk of complications such as bleeding and infection.

The qualitative data is presented through descriptive analysis, addressing the clinical outcomes, recovery durations, and problems noted in both the experimental and control groups. In the control group, patients underwent the standard technique of transvesical adenomectomy, in which removable suture and additional drainage structures were not used. Postoperative management of patients in both groups included constant monitoring of haemostasis, blood loss and possible complications.

Blood loss in the postoperative period was calculated by measuring the volume of blood collected in drainage systems, including the polyurethane tube, and accounting for the blood absorbed by surgical sponges. The weight of blood-soaked sponges was recorded and converted into volume using the absorption coefficient of the sponge material. Additionally, blood samples were taken to measure haemoglobin and haematocrit levels preoperatively and on postoperative days 1, 3, and 6. A decrease in these levels was used to estimate further blood loss. The total blood loss was determined by summing the measurements from drainage, sponges, and haemoglobin reduction, with blood transfusion considered if blood loss exceeded 400 ml or haemoglobin levels dropped below 90 g/L. It is important to clarify that blood was released through the drainage system, mixed with urine. Moreover, blood loss was calculated by studying the haematocrit levels in the fluids released through the drains, providing a more accurate assessment of the total blood loss during the postoperative period.



a) urethra; b) polyurethane tube; c) catheter; d) prostate bed; e) purse string suture; f) bladder incision

Diagram of surgical setup for transvesical adenomectomy

In the main group, drainage tensioning was performed up to the level of the upper third of the tibia, which contributed to the improvement of fluid outflow from the operation area and prevention of blood stasis. In 6 hours after the operation, the drainage tension was loosened to prevent compression complications. The removal of the polyurethane tube in the main group was performed on the second day after surgery. The urethral catheter balloon in the main group continued to provide haemostasis due to pressure on the wound surface and was removed after 5-6 days. The removable suture, made of polyglycolic acid, was dissolved automatically within 90 days, contributing to the restoration of natural contraction of the prostate bed and preventing the development of recurrent bleeding. Therefore, patients were sent home to wait for the sutures to dissolve independently.

In the control group, patients underwent standard postoperative follow-up, in which the standard urethral catheter was removed on the fifth day, without the use of additional methods to prevent bleeding. In both groups, ultrasound duplex scanning of the pelvic organs using GE Voluson E10 (USA) was regularly performed to monitor blood flow in the area of surgery and to detect possible complications. Laboratory blood tests were performed on the first, third, and sixth days after surgery to assess the level of haemoglobin, haematocrit, as well as inflammatory markers, including C-reactive protein and leukocyte formula. These data made it possible to objectively assess the rate of patient recovery and the incidence of postoperative complications in both groups, which made it possible to perform their comparative analysis.

SPSS Statistics version 27 programme (No. CJ6Y9ML) was used for statistical processing of the data. Quantitative data were presented using non-parametric statistics, including interquartile range for blood loss, haemoglobin levels, and complication rates. The normality of the data distribution was evaluated using the Shapiro-Wilk test [10]. Since the data did not fully adhere to a normal distribution, non-parametric methods were applied for the analysis. The differences between the groups were assessed using non-parametric tests, and the results were

presented in terms of interquartile range. The incidence of complications was assessed using the χ^2 criterion [11]. Differences between groups were considered statistically significant at the $p<0.05$ level.

All patient procedures were performed in strict compliance with the World Medical Association Declaration of Helsinki [12], which regulates ethical standards for medical research involving human subjects. The study was approved by the local ethical committee of the Kyrgyz Republican Scientific Society of Urologists No. E-56419. All patients provided informed consent to participate in the study, having previously familiarized themselves with the possible risks and benefits of the proposed method.

RESULTS AND DISCUSSION

The use of modified removable purse-string suture with polyurethane tubing during transvesical adenomectomy in patients with benign prostatic hyperplasia showed high efficiency in reducing blood loss and accelerating postoperative recovery. The study found that the volume of blood loss in patients in the main group, where the modified technique was used, was significantly lower in the first 48 hours after surgery compared to the control group, where the standard technique without removable suture was used.

In the main group, the average volume of blood loss was 240 [200-280] ml, which is significantly less than in the control group, where this figure reached 385 [320-450] ml. Statistical analysis using non-parametric methods confirmed the significance of differences between the groups ($p<0.05$). This indicates that the use of modified purse-string suture provided better control of bleeding in the early postoperative period. It is important to note that reducing the volume of blood loss plays a critical role in accelerating the patients' recovery after surgery, because reducing blood loss reduces the risk of postoperative anaemia and other complications associated with blood loss.

The haemoglobin level in the blood of patients after surgery was found to be an important indicator of the effectiveness of haemostasis. The data showed that haemoglobin remained higher in the main group throughout the follow-up period compared to the control group. On the first day after surgery, the haemoglobin level in the main group was 112.3 [103.9-120.7] g/L, which was 7.8 g/L higher than in the control group, where it was 104.5 [96.9-112.1] g/L. This indicates less blood loss in the patients of the main group, which helped to maintain a more stable haemoglobin level and accelerated recovery after surgery.

On the third day, the differences in haemoglobin levels between the groups became even more marked. The haemoglobin level reached 118.6 [11.5-125.7] g/L in the main group, whereas in the control group it was 109.3 [102.4-116.2] g/L. Statistical analysis confirmed that this difference was significant ($p<0.05$), indicating better patient recovery with the modified technique. Higher haemoglobin level indicates less blood loss and better blood supply to the tissues after surgery.

By the sixth day after surgery, haemoglobin levels had stabilized in all patients, but the difference between the main and control groups remained. In the main group, the haemoglobin level was 122.4 [115.9-128.9] g/l, whereas in the control group it was 114.5 [107.7-121.3] g/l. The data in Table 1 show that the use of modified removable purse-string suture contributes to the faster and more stable recovery of haemoglobin level, which positively affects the general condition of patients and reduces the risk of postoperative complications associated with anaemia and blood loss.

Table 1

Blood loss and haemoglobin levels in patients of the main and control groups (Me [Q_1-Q_3])

Indicator	Main group (n=30)	Control group (n=30)
Blood loss in the first 48 hours (ml)	240 [200-280]	385 [320-450]
Haemoglobin on the first day (g/l)	112.3 [103.9-120.7]	104.5 [96.9-112.1]
Haemoglobin on the third day (g/l)	118.6 [11.5-125.7]	109.3 [102.4-116.2]
Haemoglobin on the sixth day (g/l)	122.4 [115.9-128.9]	114.5 [107.7-121.3]

Notes: n – the number of patients in each group; Me – median; Q_1 – first quartile; Q_3 – third quartile; statistical significance was assessed using non-parametric tests, and differences between the main and control groups were considered statistically significant at p-value <0.05.

The results of the study showed that the use of a removable suture reduces the need for blood transfusion, which reduces the burden on the patient's body and minimizes the risk of complications associated with haemotransfusion. In the control group, 20% of patients required blood transfusion in the first

few days after surgery due to significant blood loss, whereas there were no such cases in the main group. This emphasizes the advantage of modified suture in effective control of blood loss.

Thus, the results of the study showed that the use of a modified removable purse-string suture with polyurethane tubing in patients with BPH undergoing transvesical adenomectomy resulted in a significant reduction in blood loss and improved recovery of haemoglobin levels. This allowed patients in the main group to recover faster after surgery, reduce the risk of complications associated with anaemia, and avoid the need for blood transfusion. These data confirm the effectiveness of using this technique as a safer and more reliable technique for patients undergoing prostate surgery.

The analysis of the incidence of postoperative complications in patients who underwent transvesical adenomectomy with the use of modified removable purse-string suture showed significant differences between the main and control groups (Table 2). The use of the modified method significantly reduced the incidence of complications such as bleeding, inflammatory reactions and haematoma formation, which significantly improved the treatment outcomes.

Table 2

Frequency of postoperative complications in the main and control groups (Me [Q_1-Q_3])

Type of complication	Main group (n=30)	Control group (n=30)
Bleeding	**0% (0/30)**	**13.3% (4/30)**
Inflammatory reactions	**6% (2/30)**	**6.7% (2/30)**
Overall complication rate	**6% (2/30)**	**20% (6/30)**
Average duration of antibiotic therapy (days)	**5.2 [4-6]**	**7.8 [6-9]**

Notes: the probability of differences between groups for categorical variables was assessed using Fisher's exact test (due to small sample sizes); for continuous variables, non-parametric tests were applied; differences were considered statistically significant at $p<0.05$.

In the control group, where the standard technique of surgery without the use of removable sutures was used, complications occurred in 20% of patients (6 cases). The most frequent complication was postoperative bleeding, which developed in 4 out of 30 patients (13.3%). These patients required additional medical intervention to stabilise the condition and prevent further blood loss. In two cases, reoperative intervention was required to stop the bleeding. In the remaining two patients, conservative methods were used, including intensification of haemostatic therapy and additional infusion therapy to restore circulating blood volume. These data indicate insufficient efficacy of the standard method of haemostasis in the prevention of bleeding after transvesical adenomectomy.

In addition, in the control group, two patients (6.7%) developed inflammatory complications such as urinary tract infections and inflammation in the area of the surgical wound. These complications required prolongation of antibiotic therapy and increased hospitalisation period. The occurrence of inflammatory complications may be associated with prolonged urethral catheter placement and inadequate drainage control in the postoperative period.

In the main group, where a modified removable suture was used, the complication rate was significantly lower, with only 6% of patients (2 cases) experiencing complications. In both cases, the complications were associated with minor inflammatory reactions that were successfully controlled by the administration of antibiotic therapy. No major bleeding or haematomas were reported in any patient in the main group, which underlines the high efficiency of the modified technique in ensuring reliable haemostasis. Through the use of a removable suture and an additional drainage system, bleeding was effectively controlled, avoiding the need for reintervention and reducing the overall complication rate.

The strategy for determining the duration of antibiotic therapy in this study is based on the incidence of postoperative complications, specifically inflammatory reactions. Patients in the main group showed better results in reducing inflammatory reactions after surgery. The mean duration of antibiotic use in the main group was 5.2 [4, 5, 6] days, whereas in the control group it was significantly higher at 7.8 [6, 7, 8, 9] days. The main group's reduced time shows that the new approach works to lower complications and speed up recovery. Antibiotics successfully reduced inflammatory reactions, mostly minor ones, and this group had fewer problems and a quicker recovery. On the other hand, the control group had more serious

inflammatory problems, like urinary tract infections and wound inflammation, that needed longer antibiotic therapy and longer hospital stays.

It is important to note that the incidence of infectious complications in the main group was minimal, which is associated with improved outflow of drainage fluids and reduced stasis in the wound. The use of a modified drainage system contributed to the effective removal of blood and exudate, which prevented the development of secondary infections. In the control group, where the removable suture was not used, the stagnation of fluid in the wound in the prostate bed led to an increased risk of infection, which explains the higher incidence of inflammatory complications in this group.

To better classify and quantify complications, the Clavien-Dindo scale [13] could be used, which categorizes complications based on their severity and the need for medical or surgical intervention. In this study, problems in the control group could be categorised as Grade II (requiring pharmacological treatment), with a few cases perhaps reaching Grade III (requiring surgical re-intervention). On the other hand, the main group would have fewer problems, most of which would be Grade I (small problems that don't need treatment). This scale would make it easier to compare and evaluate the results of different techniques and interventions.

Analysis of the complication rate revealed significant differences between the main and control groups ($p<0.05$), which confirms the effectiveness of the modified removable suture in reducing the risk of complications and improving the patients' condition after surgery. The use of the suture with polyurethane tubing significantly reduced the incidence of complications such as bleeding and inflammatory reactions, which accelerated the recovery process and reduced the need for additional medical interventions or prolongation of treatment.

The use of removable suture also resulted in a reduction in inflammation in patients in the main group compared to the control group (Table 3). Inflammatory markers including C-reactive protein (CRP) and leukocyte count were used for evaluation. Although both groups showed elevated levels of CRP after surgery, the main group's CRP levels returned to normal faster, which means that inflammation was better controlled and recovery after surgery was faster. This suggests that the improved approach helped lower the severity and length of the inflammatory response.

Table 3

Indicators of inflammatory markers in patients of the main and control groups (Me [Q_1-Q_3])

Indicator	Main group (n=30)	Control group (n=30)
CRP level on the first day (mg/l)	14.8 [12.3-17.3]	20.3 [16.5-24.1]
CRP level on the third day (mg/l)	12.3 [10.1-14.5]	17.6 [14.1-21.1]
CRP level on the sixth day (mg/l)	8.9 [7.2-10.6]	14.2 [11.3-17.1]
Leukocyte level on the first day ($\times 10^9$/l)	9.4 [8.3-10.5]	11.2 [9.9-12.5]
Leukocyte level on the third day ($\times 10^9$/l)	8.3 [7.4-9.2]	9.9 [8.8-11.0]
Leukocyte level on the sixth day ($\times 10^9$/l)	6.8 [6.1-7.5]	8.5 [7.5-9.5]

Note. Statistical analysis was performed using non-parametric methods, with the level of significance set at p-value <0.05 for differences between the main and control groups.

On the first day after surgery, the level of C-reactive protein in the patients of the main group was 14.8 [12.3-17.3] mg/l, which was significantly lower compared to the control group, where this index reached 20.3 [16.5-24.1] mg/l. This indicates a milder inflammatory reaction in the patients of the main group and better adaptation of the organism to the surgery. C-reactive protein is a sensitive marker of inflammation, its increase signals an acute inflammatory process, which can occur as a result of the intervention itself and in connection with postoperative complications.

On the third day, the level of CRP in the patients of the main group continued to decrease, reaching 12.3 [10.1-14.5] mg/l, while in the control group it decreased to 17.6 [14.1-21.1] mg/l, remaining significantly higher ($p<0.05$). This shows that the inflammatory process subsided faster in the patients of the main group, whereas in the control group, inflammation remained at a higher level. This is probably

due to the fact that the modified suture provided better haemostasis and reduced the risk of haematoma formation, which decreased the intensity of inflammatory reactions.

By the sixth day the CRP level in the patients of the main group was 8.9 [7.2-10.6] mg/l, which is almost normal value indicating the end of the inflammatory process and successful recovery. In the control group, the CRP level on the sixth day was 14.2 [11.3-17.1] mg/l, which remained above the norm and indicated prolonged inflammation. These data confirm that the use of a modified removable suture accelerates the recovery process by promoting a more rapid decrease in inflammatory markers in the blood.

In addition, analysis of the leucocytic formula showed a significant difference between the groups. On the first day after surgery in the main group, the average leucocyte level was 9.4 [8.3-10.5]×10^9/L, while in the control group, this index was significantly higher – 11.2 [9.9-12.5]×10^9/L. The increased level of leucocytes in the control group indicates the presence of a more pronounced inflammatory process. In the main group, the leucocytic formula was closer to normal, which confirms less intensity of inflammation.

By the third day, the leucocyte level in the main group decreased to 8.3 [7.4-9.2]×10^9/L, while in the control group it was 9.9 [8.8-11.0]×10^9/L. These data indicate that in the patients who used the modified technique, inflammation was more quickly eliminated, and the leucocyte level returned to normal values more quickly. On the sixth day the leucocyte level in the patients of the main group was 6.8 [6.1-7.5]×10^9/L, whereas in the control group it was higher – 8.5 [7.5-9.5]×10^9/L ($p<0.05$), which confirms slower recovery in the control group.

Statistical analysis of the data revealed significant differences in the levels of C-reactive protein and leucocyte formula between both groups at all stages of the postoperative period ($p<0.05$). This confirms that the use of a modified removable suture not only reduces blood loss and complications, but also accelerates the recovery process by reducing the intensity of inflammatory reactions.

Thus, the results of the study confirm that the modified removable purse-string suture with polyurethane tubing can significantly reduce the level of inflammatory markers in patients undergoing transvesical adenomectomy. This contributes to a faster and safer recovery, reduced risk of complications and shorter hospitalization period.

The results of the study showed significant differences in the recovery time of patients after transvesical adenomectomy between the main and control groups (Table 4). The use of a modified removable purse-string suture with polyurethane tubing in the main group contributed to a faster recovery and shorter time to urethral catheter removal compared to patients in the control group, where the standard technique without a removable suture was used.

Table 4

Indicators of recovery and time of removal of the urethral catheter in patients of the main and control groups (Me [Q_1-Q_3])

Indicator	Main group (n=30)	Control group (n=30)
Time to catheter removal (days)	**5.1 [4.7-5.5]**	**6.3 [5.8-6.8]**
Time to complete restoration of urodynamics (days)	**6.4 [5.8-7.0]**	**7.8 [7.1-8.5]**
Rate of re-intervention due to complications (%)	**0%**	**6.7%**

Note. The statistical comparison was done using non-parametric tests, and the significance threshold was p-value <0.05.

The mean time to urethral catheter removal in the main group was 5.1 [4.7-5.5] days, whereas in the control group it was significantly longer – 6.3 [5.8-6.8] days ($p<0.05$). This shows that the use of modified haemostasis technique allowed faster stability and normalization of urodynamics, which resulted in shorter time to catheter removal. In the control group, patients required the catheter longer due to increased risk of complications such as bleeding and inflammatory reactions, which delayed recovery and postponed catheter removal.

Earlier urethral catheter removal in patients in the main group was associated with better control of haemostasis and reduced risk of rebleeding, reducing the need for prolonged bladder drainage. In the control group, an average of 20% of patients experienced postoperative bleeding problems, which required longer catheter placement to control fluid

outflow and stabilize the condition. In the main group, such complications were practically not observed, which confirms the effectiveness of the modified technique.

Additionally, patients in the main group showed a faster recovery of normal urodynamics, which reduced the risk of urinary stasis in the bladder and decreased the likelihood of infectious complications. The mean time to complete recovery of normal urination (without catheter and drainage systems) in the main group was 6.4 [5.8-7.0] days, while in the control group this process took up to 7.8 [7.1-8.5] days ($p<0.05$). Early recovery of normal urination in the main group can be explained by the better condition of the postoperative bed of the prostate, which allowed avoiding complications related to the disturbance of urodynamics and urinary tract infection.

The advantages of the modified removable suture also included a reduction in the number of cases requiring reintervention due to complications related to urinary retention or haematoma formation in the surgical area. In the main group, no patient required additional intervention to correct urodynamics, whereas in the control group, two patients required reinsertion of the catheter due to a complication. This further confirms that the modified technique has a positive effect on the recovery process and reduces the risk of the need for repeated interventions.

Thus, the results of the study demonstrate that the use of a modified removable purse-string suture with polyurethane tubing contributes to faster recovery of normal urodynamics, decreased time to catheter removal, and fewer complications associated with urinary dysfunction. Patients in the main group recovered faster, which reduced the total period of hospitalization and minimized the risk of infectious and urodynamic complications.

The use of modified removable purse-string suture with polyurethane tubing during transvesical adenomectomy in patients with BPH showed a significant reduction in blood loss. In particular, patients in the main group had a mean volume of blood loss in the first 48 hours equal to 240 [200-280] ml, which is 145 ml less compared to the control group. In order to limit blood loss during prostate surgeries and emphasise the value of individualised care, M. Gorety et al. [14] created the “Maria Screening Instrument” to evaluate the risk of bleeding following an open prostatectomy. In order to identify patients who are more likely to experience complications like bleeding, the study highlights the necessity of an assessment tool. This is supported by the results of the current study, which show that using a modified removable suture during transvesical adenomectomy significantly reduced blood loss.

The incidence and treatment of bladder neck stenosis following open prostate adenectomy were the main topics of the T. Borkowski et al. [15] study. According to the study, internal optical urethrotomy was very successful in treating these cases, even though this complication happened more frequently after transvesical adenomectomy (1.05%) than after Millin's operation (0.52%). This is supported by the current study, which acknowledges the possibility of complications like bleeding and inflammatory responses but provides a novel remedy in the form of modified removable sutures that significantly reduced blood loss and the frequency of complications. The current study's method of decreasing blood loss and speeding up recovery stands out as an efficient way to manage surgical complications.

A case of a giant prostatic adenoma and its successful removal via transvesical adenomectomy was presented by A. El Alaoui and H. El Boté [16]. The authors highlighted the complexity of cases involving patients with particularly large prostates by demonstrating the use of open surgery in these patients. This strategy is supported by the results of the current study, which also included patients who had transvesical adenomectomy and had large prostates. The main distinction, though, is in the postoperative care. The present study demonstrated that the use of modified removable sutures greatly enhanced recovery outcomes, including decreased blood loss and a faster recovery, indicating a more sophisticated method of treating large adenomas.

After transvesical prostatectomy, L. Dell'Atti and R. Galeotti [17] reported a rare pseudoaneurysm complication that caused severe postoperative bleeding. For this complication to be successfully treated, an interventional radiology approach was necessary. However, as demonstrated by the lower incidence of postoperative bleeding in the main group, the current study's use of a modified removable purse-string suture successfully reduced the risk of bleeding and associated complications. Although the Dell'Atti and Galeotti study highlighted the difficulties in managing severe complications after surgery, the current study offers a safer alternative to managing bleeding risks.

According to A.M. Bove et al. [18], patients who have had an open transvesical adenomectomy in the past can have a robot-assisted laparoscopic radical prostatectomy. According to their research, the results of follow-up prostate cancer surgeries are not substantially harmed by previous open surgery. The results of the current study support this viewpoint since they also addressed the recuperation of patients who had transvenous adenomectomy, but they did so with an emphasis on enhancing immediate postoperative

results by better controlling inflammation and blood loss. The current study emphasises the significance of optimising recovery following BPH surgery itself, offering a more seamless path to potential subsequent procedures, including those involving robotic surgery, whereas Bove et al. concentrated on a different stage of care – prostate cancer surgery following BPH treatment.

M. Mdivnishvili et al. [19] presented a case report on giant BPH, highlighting the challenges and complexities involved in treating significantly enlarged prostates. In order to address the elevated dangers associated with big prostates, the case demonstrated the necessity of sophisticated surgical procedures and cautious postoperative management. These findings are also supported by the current study, which focusses on improving surgical methods for BPH. It highlights the significance of altered surgical strategies to reduce problems including inflammation and blood loss, especially in patients with more severe types of BPH.

According to V. Cornejo-Dávila et al. [20], a group of patients with prostate volumes greater than 80 grammes had the results of open transvesical adenomectomy for BPH. Their research showed a high rate of postoperative complications, such as prolonged hospital stays and the requirement for blood transfusions. Blood loss was the main cause of the complications, which was similar to the current study's findings. However, the current study showed that using a modified surgical technique was a more effective way to reduce these risks. The primary distinction is found in the recovery results: the current study demonstrated a quicker recovery and less blood loss in contrast to the Cornejo-Dávila study's higher transfusion rates and lengthier hospital stays.

According to L. Vale and L. Fossion [21], endoscopic transvesical adenomectomy demonstrated encouraging outcomes, including shorter surgical times, less blood loss, and successful functional outcomes. With the use of a modified removable suture demonstrating better blood loss control and quicker recovery times, the current study is similar in its focus on reducing complications and improving recovery following BPH surgery. The current study offers more proof that improving surgical techniques, like better haemostasis with modified sutures, can further improve postoperative outcomes, even though Vale and Fossion emphasise the value of a minimally invasive approach.

In order to overcome the drawbacks of conventional open prostatectomy techniques, including the transvesical and retropubic methods, V.I. Horovyi et al. [22] developed a novel transcervical transvesical prostatectomy approach. Similar to the current study's findings, they discovered that this novel technique led to minimal intraoperative blood loss and few immediate postoperative complications. While the transcervical method shows promise, further improvements to postoperative care and surgical techniques, like those in the current study, can further optimise outcomes. This is demonstrated by the study's emphasis on the use of a modified suture technique, which further enhances haemostasis and reduces complications like bleeding and inflammation.

In their comparison of retropubic and transvesical prostatic adenomectomies in BPH patients, L.R. Gnammi et al. [23] demonstrated that the retropubic technique led to shorter catheterisation times and less blood loss than the transvesical method. The modified transvesical technique with removable sutures, on the other hand, considerably decreased blood loss and complications, making it a more effective choice than the conventional transvesical approach, according to the current study. While the current research helps to improve the transvesical approach, providing a promising alternative with fewer postoperative complications, the study by Gnammi et al. emphasises the advantages of the retropubic method.

Despite the high risk of postoperative complications like infections and urine retention, N. Coulibaly et al. [24] found a low mortality rate and manageable morbidity following transvesical prostatectomy at the University Hospital of Libreville. This is consistent with the results of the current study, which showed that the modified transvesical adenomectomy technique had a low incidence of complications, especially bleeding. However, the current study offers a novel approach to accelerating recovery and lowering complications, demonstrating that improved surgical techniques can produce even better outcomes than conventional procedures.

The morbidity and mortality linked to open prostatectomy for BPH using the transvesical approach in Togo were the main focus of G. Botcho et al. [25]. Urinary incontinence and infections were the main complications, and they discovered a comparatively low death rate. The results of the current study indicate that even transvesical adenomectomy can have markedly better postoperative results with sophisticated techniques like the use of removable sutures, but their study shows that open prostatectomy is still a legitimate treatment in some situations. As seen in the current study, the use of modified suturing techniques may result in even fewer complications and quicker recovery periods.

In conclusion, the current study demonstrated that the use of a modified removable purse-string suture with polyurethane tubing can significantly improve postoperative outcomes in patients with BPH. Reduced blood loss, improved inflammatory markers and shorter recovery time confirm the

efficacy of this technique and the need for its widespread use in clinical practice.

CONCLUSIONS

1. The use of a modified removable purse-string suture with polyurethane tubing significantly reduced blood loss during the first 48 hours after surgery. Patients in the main group experienced an average blood loss of 240 [200-280] ml, compared to 385 [320-450] ml in the control group. Haemoglobin levels remained higher in the main group throughout the postoperative period, indicating reduced blood loss and more efficient recovery. On the first day, the mean haemoglobin level was 112.3 [103.9-120.7] g/L, which was 7.8 g/L higher than in the control group. These differences persisted on the third and sixth postoperative days.
2. The incidence of postoperative complications was significantly lower in the main group. In the control group, 20% of patients experienced complications, primarily bleeding and inflammatory reactions, while in the main group, complications were observed in only 6% of cases and were successfully managed with antibiotic therapy.
3. The mean time to urethral catheter removal was 5.1 [4.7-5.5] days in the main group, significantly shorter than 6.3 [5.8-6.8] days in the control group ($p<0.05$), indicating a faster recovery process.
4. The differences in all key indicators, including blood loss, haemoglobin levels, complication rates, and recovery times, were statistically significant ($p<0.05$), with the main group showing better outcomes.
5. Despite the positive results, the study is limited by the small sample size and short follow-up period. Larger multicentre studies with extended follow-up are needed to confirm the long-term efficacy and safety of this technique. Future research should explore the potential for incorporating advanced technologies, such as real-time monitoring and AI-assisted surgery, to enhance surgical outcomes and patient recovery.

Contributions:

Botalaev B. – conceptualization, writing – review and editing, project administration, supervision;

Usupbaev A. – resources, formal analysis, writing – review and editing;

Abdykalykov M. – methodology, formal analysis, investigation, resources, writing – original draft;

Zhumagaziev T. – methodology, formal analysis, investigation, writing – original draft;

Mailubashev M. – formal analysis, writing – review and editing.

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