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Urethra–preserving (extraurethral) prostatectomy for benign prostatic hyperplasia: the evolution from open to laparoscopic robot–assisted surgery

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The first transurethral prostatectomy involving complete removal of the hyperplastic lobes of the prostate was performed by the American surgeon E. Fuller in 1895 [1]. In 1919, Soviet surgeon A. T. Lidsky began developing suprapubic access and a technique for suprapubic (transcapsular) urethra–preserving (extraurethral) prostatectomy for benign prostatic hyperplasia using cadavers [2]. Key features of these techniques: access to the bladder and prostate is achieved through a small (4–6 cm) skin incision in the suprapubic region; the capsule is incised longitudinally while preserving the integrity of the prostatic portion of the urethra; drainage of the bed of the removed prostate lobes using a gauze tampon through an additional perineal incision; drainage of the bladder via a urethral catheter. However, A. T. Lidsky's developments did not find practical application.

In 1945, the Irish urologist T. Millin [3, 4] proposed open retropubic (transcapsular) prostatectomy for the treatment of benign prostatic hyperplasia. Both open transvesical and retropubic prostatectomies, as well as transurethral resections of the prostate (introduced in the 1930s) involved the removal of hyperplastic prostate lobes along with the prostatic portion of the urethra, creating a prostatic bed.

Urethra–preserving (extraurethral) transvesical and retropubic prostatectomies were first introduced in 1973 by Professor M. F. Sergienko, who widely promoted these techniques in the USSR [5]. He and his colleagues performed more than 3,000 extraurethral transvesical and retropubic prostatectomies [6, 7]. In Ukraine, V. V. Zhyla—a professor in the Department of Urology at the Kyiv Medical Academy of Postgraduate Education—was an advocate of extraurethral transvesical prostatectomy [8]. Unfortunately, Sergienko's extraurethral transvesical and retropubic prostatectomies did not find application in the clinical practice of Soviet urologists due to the complexity of performing open surgeries and the adhesions between the hyperplastic lobes of the prostate gland and the prostatic portion of the urethra.

In Ukraine, transurethral prostatectomy was first performed in 1969 in the urology department of the M. I. Pirogov Vinnytsia Regional Hospital [9]. Despite having performed more than 2,000 transurethral prostatectomies, the anterior portion of the urethra was never preserved intact. In 2–5% of procedures, and in cases where only two lateral hyperplastic lobes of the prostate were present, it was possible to preserve a strip of the posterior wall of the prostatic portion of the urethra, which connected the bladder neck to the seminal colliculus.

M. R. Madigan and A. R. Dixon [10] prioritize urethra–preserving (extraurethral) prostatectomy; they described the performance of 59 open transperineal prostatectomies according to T. Millin with preservation of the prostatic portion of the urethra. Abroad, open extraurethral prostatectomy has also not gained popularity.

A revolutionary milestone in urology was achieved in 2002 when M. B. Mariano and colleagues [11] performed the first laparoscopic prostatectomy for benign prostatic hyperplasia, followed in 2008 by the first laparoscopic robot–assisted prostatectomy performed by R. Sotelo and colleagues [12]. Stepwise intraoperative hemostasis, excellent visualization, and precision in performing the procedure allowed the prostatic portion of the urethra to remain intact during these minimally invasive prostatectomies when only two lateral hyperplastic lobes of the prostate were present.

When performing laparoscopic extraperitoneal retropubic (transcapsular) prostatectomy, in approximately 20% of patients, the prostatic portion of the urethra is preserved or only partially damaged [13] (*Figs. 1, 2*).

C. Quan and colleagues [15] performed 16 laparoscopic extraperitoneal retropubic prostatectomies for large–sized benign prostatic hyperplasia—the average weight of the resected lobes was (104.7 ± 23.3) g – with preservation of the prostatic portion of the urethra; however, in 20% of these cases, the urethra was partially damaged. No patient required a blood transfusion, and none developed urinary incontinence after surgery.

N. Xing and colleagues [16] performed 51 laparoscopic extraperitoneal retropubic prostatectomies. In 28 patients,

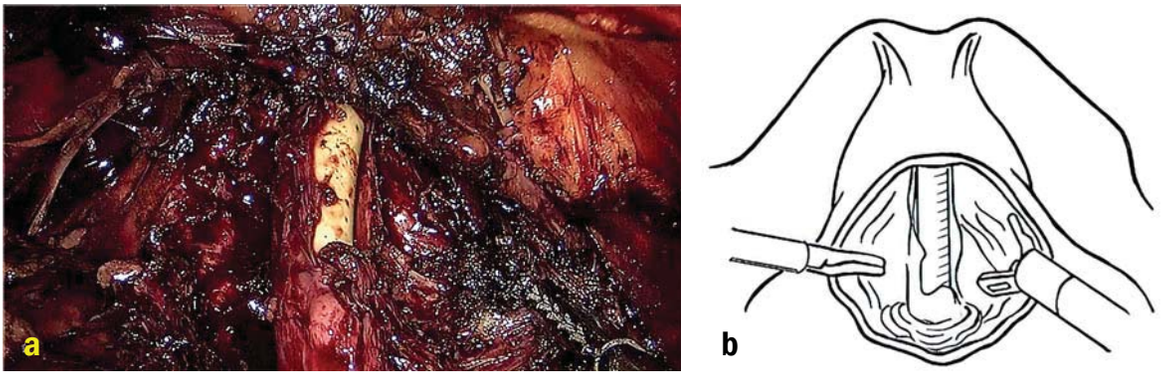

Fig. 1.
Partial injury to the anterior surface of the prostatic portion of the urethra during laparoscopic extraperitoneal retropubic (transcapsular) prostatectomy in the absence of the middle hyperplastic lobe of the prostate:
a – view of the surgical wound, b – schematic illustration [13].

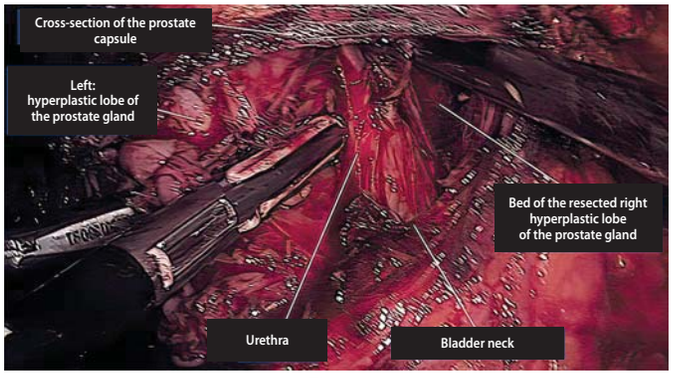

Fig. 2.
Laparoscopic extraperitoneal retropubic urethra-preserving prostatectomy in the absence of a middle hyperplastic lobe of the prostate.
Stage of removal of the left hyperplastic lobe of the prostate. The intact prostatic portion of the urethra [14].

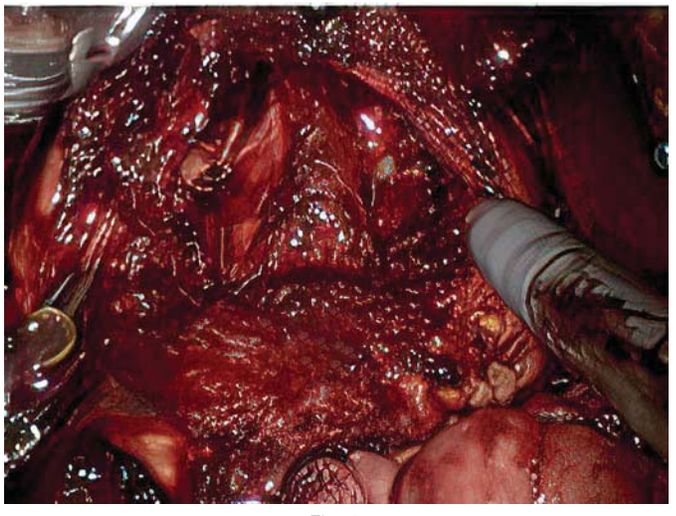

Fig. 3.
Laparoscopic robot-assisted extraperitoneal trans-capsular extraurethral prostatectomy according to P. Wang et al. [18].
Intraoperative view of the intact prostatic portion of the urethra (indicated by the arrow) after removal of the hyperplastic portions of the prostate gland.

the prostatic portion of the urethra was preserved; in 19, minor perforations were noted and sutured with absorbable sutures. Only 2 patients received a blood transfusion; the mean intraoperative blood loss was (232.55 ± 199.54) mL. There were no postoperative complications, including urinary incontinence. The surgeries were performed with preservation of the prostatic portion of the urethra in the absence of a hyperplastic middle lobe of the prostate. In cases where it was present, open prostatectomy was performed.

H. Qian and colleagues [17] used the fluorescent dye indocyanine green in 14 patients to preserve the prostatic portion of the urethra during laparoscopic transperineal prostatectomy according to M. R. Madigan.

The increased range of motion of the instruments and three–dimensional visualization have contributed to the widespread adoption of laparoscopic robot–assisted extraperitoneal prostatectomy for benign prostatic hyperplasia. P. Wang and co–authors [18] performed the first laparoscopic robot–assisted extraperitoneal transcapsular extraurethral prostatectomy in 2018 on 26 patients with benign prostatic hyperplasia (*Fig. 3*). The average duration of the procedure was 169 minutes, and the average blood loss was 235 ml. In 7 (26.9%) patients, it was necessary to suture damage to the urethra. Of the 14 patients who retained erectile function after surgery, 13 had normal ejaculation, and 1 had retrograde ejaculation.

F. Porpiglia and colleagues [19] reported the results of 92 laparoscopic robot–assisted transperitoneal transcapsular urethra–preserving prostatectomies. In cases where the middle hyperplastic lobe of the prostate was present, it was removed via an incision in the anterior wall of the bladder. In 56 (60.86%) patients, the prostatic portion of the urethra was preserved intact; in 21 (22.82%), it was minimally damaged; and in 15 (16.30%), the urethra could not be preserved. The average prostate volume was 140 ml, the average duration of the operation was 110 minutes, and the average blood loss was 200 ml. In 81% of patients, there

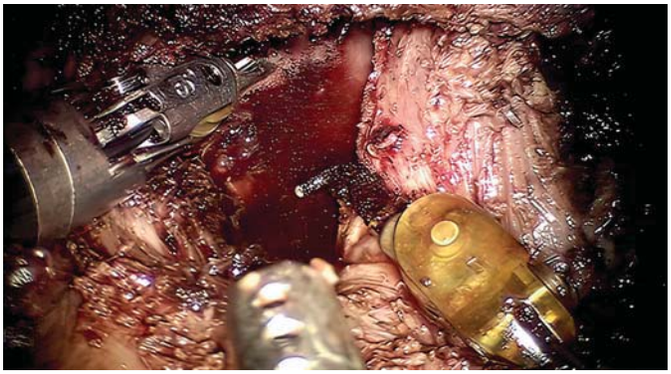

Fig. 4.
Laparoscopic robot-assisted transperitoneal transcapsular urethra-preserving prostatectomy. Resection of the left hyperplastic lobe of the prostate and hemostasis of the gland bed. The prostatic portion of the urethra is intact [26].

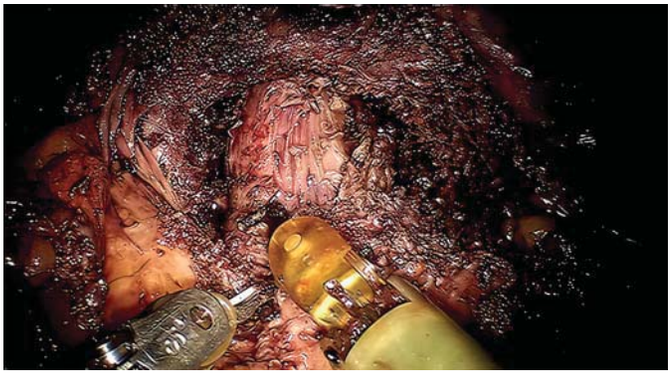

Fig. 5.
Laparoscopic robot-assisted transperitoneal transcapsular urethra-preserving prostatectomy. Both hyperplastic lobes of the prostate gland were removed. Reduction in the size of the prostate bed due to contraction of its capsule [26].

was no retrograde ejaculation 12 months after surgery. In 2022, these authors reported the results of urethra–preserving prostatectomy in 124 patients [20]. There were no postoperative complications exceeding Clavien–Dindo Class II [21]; 15 (12%) patients experienced the following complications: mild hematuria after removal of the urethral catheter – 4 (3.2%), acute urinary retention after removal of the urethral catheter – 3 (2.4%), urine leakage via the safety drain – 3 (2.4%), postoperative hyperthermia – 5 (4%). The average duration of bladder drainage via urethral catheter was 4 days, the number of postoperative bed–days was 5, and the maximum urinary flow rate (Qmax) ranged from 20 to 29 mL/s. It was concluded that laparoscopic robot–assisted urethra–preserving prostatectomy for benign prostatic hyperplasia effectively eliminates the obstructive symptoms of the disease and postoperative retrograde ejaculation. No postoperative urinary incontinence was observed.

G. Simone et al. [22] During laparoscopic robot–assisted transperitoneal transcapsular extraurethral prostatectomy in 12 patients, indocyanine green was administered retrograde through the urethra into the bladder to prevent damage to the prostatic portion of the urethra. The mean prostate volume was 102 cm³, the mean duration of the procedure was 150 minutes, and the mean blood loss was 250 mL. In 66% of patients, there was no retrograde ejaculation after the procedure.

S. W. Choi and colleagues [23] reported the results of 30 laparoscopic robot–assisted extraperitoneal trans–capsular urethra–preserving prostatectomies in patients without a median hyperplastic lobe of the prostate. The mean duration of the procedure was 123.4 minutes, and the mean blood loss was 151.3 ml. In 78.6% of patients, there was no retrograde ejaculation after surgery.

Y. S. Shin and colleagues [24] compared the outcomes of 20 laparoscopic robot–assisted transcapsular urethra–preserving and 22 laparoscopic robot–assisted transvesical (through the dome of the bladder without preserving the prostatic portion of the urethra) prostatectomies for benign prostatic hyperplasia. The procedures did not differ statistically significantly in terms of duration and volume of intraoperative blood loss. However, after urethra–preserving prostatectomy, urinary flow quality as measured by Qmax recovered more rapidly, and the incidence of postoperative retrograde ejaculation was lower.

X. Chen and colleagues [25] proposed performing urethra–preserving laparoscopic robot–assisted prostatectomy for benign prostatic hyperplasia via the rectovesical space (pocket).

Since 2025, we have also implemented laparoscopic robot–assisted transperitoneal transcapsular urethra–preserving prostatectomy for the treatment of patients with benign prostatic hyperplasia [26] (*Figs. 4, 5*).

Thus, a review of the literature and our own experience with open, laparoscopic, and robot–assisted prostatectomies indicate the feasibility of urethra–preserving (extraurethral) prostatectomy in minimally invasive laparoscopic and robotic procedures. Minimally invasive laparoscopic and robot–assisted urethra–preserving prostatectomies allow for improved surgical outcomes in patients with large benign prostatic hyperplasia (greater than 80 cm^3): reduce the duration of postoperative bladder drainage and the number of postoperative hospital days, the incidence of urinary incontinence and retrograde ejaculation, inflammatory processes in the testicles and epididymis, the incidence of erectile dysfunction, and other postoperative complications.

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