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ORIGINAL RESEARCH

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Influence of urethral preservation combined with posterior urethral reconstruction on postoperative urinary control in patients undergoing radical resection of prostate cancer

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Abstract

Background: To explore the influence of retrourethral fascia reconstruction technique on postoperative urine control and therapeutic effectiveness in prostate cancer patients undergoing radical prostatectomy. **Methods**: In this retrospective study, we included 80 patients with prostate cancer admitted between January 2019 and December 2023. All patients were randomly divided into control group (41 cases) and observation group (39 cases). All participants gave their consent and had full knowledge of the research protocol. The control group received laparoscopic radical prostate cancer resection, while the observation group underwent retrourethral sphincter fascia reconstruction. The study compared surgical parameters, postoperative pathological findings, urinary tract control after surgery, and evaluations of quality of life between the two groups. **Results**: Intraoperative blood loss and Operation time were not significantly different between the two groups ($p > 0.05$). There were no significant differences in Postoperative Gleason score, Postoperative pathological stage and Positive margin between the two groups ($p > 0.05$). There were no significant differences in catheter removal time, postoperative hospitalization time and postoperative feeding time between the two groups ($p > 0.05$). The recovery rates of urine control were 53.66% (22/41) and 70.73% (29/41) at 3 months and 6 months, respectively, in the control group, and 79.49% (31/39) and 94.87% (37/39) at 3 months and 6 months, respectively, which were significantly higher than those of the control group ($p < 0.05$). At 3 months and 6 months after surgery, International Incontinence Advisory Committee Urinary Incontinence Questionnaire (ICIQ-SF) score of observation group was significantly lower than that of control group, Extended Prostate Cancer Composite Index (EPIC-UIN) score was significantly higher than that of control group ($p < 0.05$). **Conclusions**: The retrourethral fascia rebuilding approach in radical prostatectomy is very safe and feasible, and it promotes better recovery of postoperative urine control based on the patient's condition.

Keywords

Prostate cancer; Laparoscopic radical; Retrourethral sphincter fascia reconstruction

1. Introduction

Prostate cancer is a prevalent malignancy that frequently affects older men, and it has the second highest fatality rate among all malignant tumors [1]. Prostate cancer rates are on the rise annually, driven by shifts in personal habits, diet, environmental factors, job conditions, population aging and various other influencing factors [2–4]. Radical prostatectomy is a highly successful method for controlling the progression of prostate cancer [5]. The method provides advantages such as minimized damage, a clearly delineated surgical site, and retention of anatomical integrity [6]. It is considered the primary therapeutic option for localized prostate cancer.

Despite this, radical prostatectomy often results in urinary incontinence for patients, especially with a high prevalence of early onset incontinence [7]. This significantly impacts the post-surgery life, as well as the physical and mental well-being of patients. Therefore, the improvement of surgical methods has become a significant focal point for urological surgeons on a global scale, with the goal of reducing instances of postoperative urinary incontinence and accelerating the recovery of postoperative urinary function. There is a potential risk of injuring the urethral fascia during the laparoscopic radical resection of prostate cancer when extracting the tumor [8]. Hence, it is crucial to undergo repair of the posterior urethral fascia [9]. Nevertheless, there is a scarcity of research

on the implementation of retrourethral fascia reconstruction technology in laparoscopic radical resection of prostate cancer. Furthermore, there are significant disparities in the findings of available studies. Hence, in conjunction with the current instances observed in our medical facility, this investigation examines the utilization of retrourethral fascia reconstruction technology in laparoscopic radical prostatectomy for prostate cancer and its impact on patients' urine incontinence.

2. Materials and methods

2.1 Patient and general information

In this retrospective study, we included 80 patients with prostate cancer admitted between January 2019 and December 2023. All patients were randomly divided into control group (41 cases) and observation group (39 cases). All patients underwent laparoscopic radical prostatectomy, and all patients agreed to and were aware of the study.

Inclusion criteria: (1) The patient was diagnosed with prostate cancer and meets the criteria for undergoing radical prostatectomy; (2) The patient is aged between 50 and 70 years; (3) All participants must voluntarily participate in the study and sign an informed consent form, fully understanding the study protocol; (4) The patient must undergo a preoperative evaluation to confirm the absence of severe comorbidities and ensure they can tolerate the surgery and postoperative recovery.

Exclusion criteria: (1) Patients with blurred consciousness and mental disorders; (2) Patients with severe organ functions such as liver and kidney; (3) Patients had poor treatment compliance and did not actively cooperate; (4) Prostate cancer has multiple metastases; (5) Patients with severe coagulation dysfunction.

2.2 Interventions

The control group participants had laparoscopic radical excision of prostate cancer using the following surgical methods:

The patient received general anesthesia and was positioned in a supine posture with the hips slightly raised and the head lowered, while the feet were elevated. During the procedure, a Trocar was placed bilaterally into the midline below the umbilical cord, via the rectus abdominis muscle, and into the top spine of the right iliac anterior. The pressure of pneumoperitoneum was set at 14 mmHg during laparoscopy performed at a 30° angle. To dissect the surface and sides of the prostatic gland, an ultrasonic knife was employed, extending the dissection to the pelvic fascia and prostatic ligament. A cut was performed in the pelvic fascia, shifting the levator anal muscle and suturing the deep dorsal vein complex of the penis with 2-0 Vicryl. Use the Freire technique to spare the bladder neck. Initially, locate the vesico-prostatic junction. Then, a precise incision was made on the anterior wall of the bladder using a unipolar electroknife. To ensure proper tension, the bladder was gently pulled by an assistant. The optimal anatomical position was carefully determined in a step-by-step manner. The proximal urethra, which was longitudinally deformed, was discovered and temporarily left uncut. It was then gradually freed in the direction of the prostate using mostly blunt ionization, with an ionization length of 0.5–1.0 cm. In order to reduce the risk of carbonization of the optic field tissue and maintain clarity, bipolar hemostatic treatment is favored over unipolar electrocoagulation intervention. After ionization therapy, the anterior wall of the urethra was excised and the urethral catheter was removed. The assistant then elevated the urethral catheter towards the abdominal wall to aid in the upward displacement of the prostate gland. Next, the electroknife was employed to meticulously eliminate the distal portion of the bladder neck membrane in a systematic manner, starting from the center and progressing towards the outer layers. This process involved removing the detrusor muscle fibers of the tube, while simultaneously ensuring that the prostate capsule remained connected to the bladder neck for ionization purposes. The ultimate goal was to achieve a thorough separation of the prostate gland from the bladder neck. During this procedure, great care is taken to ensure that the prostate covering remains intact and undamaged.

In the observation group, the posterior fascia reconstruction of the urethral sphincter was carried out based on the control group. This process entailed using scissors to sever the urethra near the prostate tip, and subsequently detaching the median fiber ridge (MFR) linking the prostate to the rear wall of the urethral sphincter. The reconstruction of the urethral sphincter was carried out in accordance with the Rocco treatment protocol. The procedure involved suturing the Denonvilliers fascia stump, located 1–2 cm behind the bladder neck, using a 3-0 absorbable suture line, MFR and a urethral spatula. The suturing was done constantly from right to left. The needle should be inserted to the depth of Denonvilliers fascia, and it is possible to suture a portion of the bladder muscle. The full integration of Denonvilliers fascia, located 1–2 cm behind the bladder neck, the MFR, and the posterior wall of the urethral sphincter was achieved. Following this, a continuous anastomosis approach was employed to connect the bladder neck and urethra using a single needle. As the bladder neck was preserved, reintroducing bladder neck restoration was deemed unnecessary. Inserting the F20 double-cavity urinary tube before completing the anastomosis procedure is essential. Following this, the anastomosis operation can proceed. To ensure there is no leakage, 100 mL of normal saline should be injected into the bladder and the drainage tube should be routinely placed.

2.3 Primary outcome

2.3.1 Surgical parameters and postoperative pathological parameters

The operative parameters, which included intraoperative time, blood transfusion rate, pelvic drainage indwelling time, and urinary catheter indwelling time, were observed and documented. Postoperative pathological factors, including postoperative Gleason score, postoperative pathological stage, and positive margin rate, were documented to evaluate the impact of the revised procedure on the probability of postoperative tumor residue. This modified approach aimed to maintain and restore a higher quantity of urinary control-related anatomical structures compared to traditional surgical methods.

2.3.2 Postoperative urinary control and quality of life assessment of patients

All patients were monitored at 3 months and 6 months following catheter removal, respectively. The follow-up assessment covered the progress of regaining urinary control. Criteria for successful urinary control restoration involved no longer needing to use a urinary pad daily, whereas urinary incontinence was defined as using at least one urinary pad. When evaluating the influence of urinary incontinence on quality of life, the International Incontinence Advisory Committee Urinary Incontinence Questionnaire (ICIQ-SF) score and the Extended Prostate Cancer Composite Index (EPIC-UIN) score were utilized. A higher ICIQ-SF score indicates a worse quality of life.

2.4 Statistical methods

Statistical software SPSS 25.0 (IBM, Armonk, NY, USA) was used to analyze the data. The normal distribution of measurement data was expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$), and T-test was performed for inter-group and intra-group comparisons. The count data were expressed as example (%) and χ^2 test was performed for comparison between groups. $p < 0.05$ indicates that the difference is statistically significant.

3. Results

3.1 Comparison of general data between the two groups

There were no statistically significant differences in age, Body Mass Index (BMI), Prostate-Specific Antigen (PSA), International Prostate Symptom Score (IPSS), maximum urinary flow rate (Qmax) and prostate volume between the two groups ($p > 0.05$), as shown in Table 1.

3.2 Comparison of surgical parameters and postoperative pathological parameters between the two groups

There was no statistically significant variance in intraoperative blood loss and operation time observed between the two groups ($p > 0.05$), as shown in Table 2.

Similarly, no notable variances were detected in postoperative Gleason score, postoperative pathological stage, and positive margin between the two groups ($p > 0.05$), as shown in Table 3.

3.3 Comparison of postoperative recovery between the two groups

There were no notable variances observed in the time taken for catheter removal, duration of postoperative hospital stay, and postoperative feeding time between the two cohorts ($p > 0.05$), as shown in Table 4.

3.4 Comparison of postoperative urinary control recovery between the two groups

The recovery rates of urine control were 53.66% (22/41) and 70.73% (29/41) at 3 months and 6 months, respectively, in the control group, and 79.49% (31/39) and 94.87% (37/39) at 3 months and 6 months, respectively, which were significantly higher than those of the control group ($p < 0.05$).

The observation group showed a notable decrease in the ICIQ-SF score and a significant increase in the EPIC-UIN score compared to the control group at both 3 months and 6 months post-surgery ($p < 0.05$), as shown in Table 5.

4. Discussion

Several factors, such as obesity, age, sedentary lifestyle and other variables, can contribute to urinary incontinence after undergoing radical prostate cancer surgery [10, 11]. Additionally, it is strongly linked to the anatomy of male urine control [12]. The ability of men to control urination is mainly affected by structures such as the urethral sphincter, urethra, puboprostatic ligament and surrounding supportive tissues. When undergoing radical prostate cancer resection, the tumor is excised by creating openings at the bladder neck and carefully separating the urethra. This procedure unavoidably results in alterations to the anatomical structures responsible for urinary control, such as the urethral sphincter and pelvic floor muscles, consequently impacting urinary control function [13].

The Rocco fascia rebuilding approach, proposed by Koliakos *et al.* [14], is a successful method for addressing these issues. The Rocco suture method was utilized to enhance the strength of the posterior wall, in addition to reinforcing the suturing technique for the anterior wall of the urethra and the deep

TABLE 1. Comparison of general data between observation group and control group ($\bar{x} \pm s$).

Project	Control group (n = 41)	Observation group (n = 39)	t	p
Age ($\bar{x} \pm s$, yr)	60.76 $\pm$ 6.18	59.51 $\pm$ 5.55	0.946	0.347
BMI ($\bar{x} \pm s$, kg/m^2)	21.27 $\pm$ 2.34	22.07 $\pm$ 1.92	1.668	0.099
PSA ($\bar{x} \pm s$, ng/mL)	8.81 $\pm$ 1.62	9.53 $\pm$ 1.92	1.810	0.074
IPSS	22.12 $\pm$ 3.92	23.33 $\pm$ 5.42	1.150	0.254
Qmax ($\bar{x} \pm s$, mL/s)	7.59 $\pm$ 3.53	8.34 $\pm$ 2.82	1.059	0.293
Prostate volume ($\bar{x} \pm s$, mL)	35.39 $\pm$ 9.81	38.41 $\pm$ 10.94	1.301	0.197

BMI: Body Mass Index; PSA: Prostate-Specific Antigen; IPSS: International Prostate Symptom Score; Qmax: maximum urinary flow rate.

dorsal muscle plexus. This led to an increased success rate in achieving early urine control among patients in the postoperative period [15]. The main goal of employing the Rocco suture technique is to relocate the external urethral sphincter as near as possible to its initial anatomical location after surgery, thereby improving the management of urinary function [16]. This project focuses on enhancing the Rocco suture technology. Preserving the bladder neck helps maintain the function of the internal urethral sphincter, while reconstructing the posterior urethral fascia can enhance urine control. The internal urethral sphincter is a cylindrical structure that surrounds the urethra. It is primarily made up of the anterolateral striated muscle and the posterior fibrous connective tissue. The myofascial flap consists of the muscle fascia rectus (MFR), the posterior wall of the urethral sphincter, the Denonvilliers fascia, and the dorsal prostatic fascia. The myofascial flap is an essential anatomical structure that provides support to the pelvic cavity and maintains the position of the posterior wall of the urethral sphincter during contraction. While performing prostate cancer surgery, the myofascial flap is cut, resulting in

TABLE 2. Comparison of surgical parameters between observation group and control group ($\bar{x} \pm s$).

Project	Control group (n = 41)	Observation group (n = 39)	t	p
Intraoperative blood loss ($\bar{x} \pm s$, mL)	153.56 ± 34.78	141.41 ± 28.80	1.697	0.094
Operation time ($\bar{x} \pm s$, min)	103.27 ± 14.90	104.41 ± 23.67	0.260	0.796

TABLE 3. Comparison of postoperative pathological parameters between observation group and control group ($\bar{x} \pm s$).

Project	Control group (n = 41)	Observation group (n = 39)	χ^2	p
Postoperative Gleason score				
≤6	15	19		
7	19	15	1.225	0.542
≥8	7	5		
Postoperative pathological stage				
pT_2	24	21		
pT_{3a}	13	12	0.690	0.875
pT_{3b}	3	5		
pT_4	1	1		
Positive margin				
Neck	3	4	0.216	0.642
Apex	6	4	0.350	0.554

TABLE 4. Comparison of postoperative recovery between observation group and control group ($\bar{x} \pm s$).

Project	Control group (n = 41)	Observation group (n = 39)	t	p
Catheter removal time ($\bar{x} \pm s$, d)	6.51 ± 0.51	6.69 ± 0.66	1.380	0.171
Postoperative hospital time ($\bar{x} \pm s$, d)	10.76 ± 1.39	10.56 ± 1.50	0.594	0.555
Postoperative feeding time ($\bar{x} \pm s$, d)	1.20 ± 0.40	1.28 ± 0.46	0.907	0.367

TABLE 5. Comparison of postoperative ICIQ-SF and EPIC-UIN scores between the two groups ($\bar{x} \pm s$).

Project	Control group (n = 41)	Observation group (n = 39)	t	p
ICIQ-SF				
3 months after surgery	11.22 ± 2.67	6.92 ± 1.95	8.183	<0.001
6 months after surgery	8.68 ± 2.55	6.67 ± 1.95	3.953	<0.001
EPIC-UIN				
3 months after surgery	61.80 ± 8.03	75.51 ± 11.60	6.170	<0.001
6 months after surgery	66.85 ± 9.56	79.46 ± 12.44	5.098	<0.001

ICIQ-SF: International Incontinence Advisory Committee Urinary Incontinence Questionnaire; EPIC-UIN: Extended Prostate Cancer Composite Index.

the tightening of the posterior wall of the urethral sphincter. This leads to a significant decrease in both functional and anatomical length [17]. Throughout the process, the method of reconstructing the posterior urethral fascia is applied to aid in the healing of the Denonvilliers fascia, which is positioned 1–2 cm behind the bladder neck, as well as the mid-urethral fascia and the posterior wall of the urethral sphincter, ultimately merging them into a unified structure. The objective is to fully restore the urine control anatomy while surgically eliminating the prostate malignancy [18].

Our investigation found no significant differences between the two groups in terms of surgical parameters and postoperative recovery. The recovery rate of postoperative urine control in the observation group was significantly higher than that in the control group, and similar results were also reflected in the studies of Andre N Vis *et al*. [15] and Xavier Hurtes *et al*. [19]. Furthermore, the ICIQ-SF and EPIC-UNI scores in the study group were significantly superior to those observed in the control group. This finding suggests that retrourethral fascia reconstruction technology outperforms the conventional technique with respect to postoperative urinary continence. This procedure has a positive impact on the postoperative recovery of patients' urinary control by reducing intraoperative blood loss and the risk of tumor residue, without prolonging the operation time. This method effectively reconstructs the periurethral and pelvic floor tissues, preserving their native anatomical positioning. The enhanced tissue healing postoperatively has markedly improved the recovery rate of urinary continence in patients. Facilitating prompt restoration of urinary control is beneficial in enhancing patients' quality of life.

This study is a single-center retrospective analysis, limited by the number of sample cases, the statistical analysis results are inevitably biased. Hence, multicentric, prospective, randomized controlled trials should be deemed essential and conducted to substantiate the efficacy of this intervention among prostate cancer patients.

5. Conclusions

Reconstruction of the retrourethral fascia utilizing advanced techniques confers distinct advantages in the comprehensive excision of prostate cancer. This approach ensures the maintenance of the urethra's anatomical integrity, facilitating surgeons' ability to safeguard and restore the structures essential for urinary function. Consequently, it enhances the proficiency of practitioners in mastering this surgical method. According to our examination of the relevant follow-up results, we have obtained specific clinical effects, which are worthy of promotion and implementation.

AVAILABILITY OF DATA AND MATERIALS

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

BL, SXC—designed the study and carried them out, supervised the data collection, prepared the manuscript for publication and reviewed the draft of the manuscript. BL—analyzed the data, interpreted the data. All authors have read and approved the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Ethics Committee of Changzhou Cancer (Fourth People's) Hospital (Approval no. AF/SC-11/05.1). Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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