Submitted: 07 March, 2023 Accepted: 10 May, 2023 Published: 30 July, 2023 DOI:10.22514/jomh.2023.060

ORIGINAL RESEARCH

JOMH Journal of Men's Health

Effect of modified extraperitoneal laparoscopic total intrafascial radical prostatectomy on clinical efficacy for prostate cancer patients

Dan Yuan[1], Kang Li[1,*], Yu Wang[1], Long Huang[1], Mingsong Wang[1], Kang Jia[1]

[1]Department of Urology, 363 Hospital, 610041 Chengdu, Sichuan, China

***Correspondence**
likang3030601@163.com
(Kang Li)

Abstract

The effective surgical treatments of localized prostate cancer patients were explored. 90 prostate cancer patients admitted to our hospital were selected as study subjects. They were divided into research (treated by modified extraperitoneal total intrafascial laparoscopic radical prostatectomy) and control (treated by extraperitoneal laparoscopic radical prostatectomy) groups by random number table method, having 45 cases each. The operation time, bleeding volume, drainage time, hospitalization time, vascular endothelial stimulation index, urinary control function, erectile function, complications, and recurrence were monitored and compared. No significant difference was found between the two groups in clinical operation related indexes. On 3rd and 7th days after operation, VEGF (Vascular Endothelial Growth Factor) and IGF-I (Insulin-like Growth Factor 1) in research group were lower than those in control ($p < 0.005$). The urine control rate and erectile function normal rate in research group were higher than those in control ($p < 0.005$). Modified extraperitoneal laparoscopic total intrafascial radical prostatectomy reduced the degrees of trauma and irritation in the operation of prostate cancer patients. Moreover, during the observation period, it improved the postoperative urinary control and erectile function of patients and reduced the complications. Thus, this method has the worth of clinical promotion and application.

Keywords

Improvement; Extraperitoneal laparoscopy; Total intrafascial radical prostatectomy; Prostate cancer; Clinical efficacy

1. Introduction

Clinical data [1, 2] show that prostate cancer incidence is the highest among malignant tumors of male urinary system. Radical prostatectomy is an effective therapeutic method for treating localized prostate cancer. This method prolongs patients' survival and has advantages of reducing postoperative intraperitoneal complications and interferences [3]. However, patients may face problems including urinary incontinence and erectile dysfunction after the operation. These problems reduce patients' life quality and affect operation outcomes. Clinical research [4, 5] has revealed that various ways of tissues excision and anatomy have different effects on patients for recovering from erectile dysfunction and postoperative urinary incontinence. This finding has been proved in clinical trials. Studies [6–8] have found that modified total intrafascial radical prostatectomy affects recovery from erectile dysfunction and urinary incontinence because of the anatomical reconstruction of anterior urethral wall. There are few clinical studies on this method and paper herein conducts clinical analysis regarding this topic.

2. Material and methods

2.1 Clinical materials

Ninety prostate cancer patients admitted to our hospital were selected as the study subjects. They were divided into research and control groups by the random number table method having 45 cases each. All radical prostatectomies were performed by one surgeon who was the deputy chief physician of Urology Department and had conducted more than 100 radical prostatectomies before this study. Table 1 depicts the clinical information of two groups having no significant differences. The study was approved by hospital ethics committee.

2.2 Therapy

2.2.1 Control group

Patients in control group underwent extraperitoneal laparoscopic radical prostatectomy. Neurovascular bundles in fascia were reserved during the operation performed under general anesthesia. Patients were supine on sickbed elevated 15 degrees high. The posture was kept like raised hips, slightly apart legs, and feet higher than heads. After disinfection, the

TABLE 1. Comparison of clinical information for two groups.

Indicators	Research group (n = 45)	Control group (n = 45)	t/χ^2 value	*p* value
Age	62.33 ± 4.26	62.40 ± 4.19	0.08	0.94
BMI (kg/m^2)	22.64 ± 2.05	22.67 ± 1.94	0.07	0.94
Prostate Volume	39.33 ± 3.25	39.29 ± 3.55	0.06	0.96
Education Background (n, %)				
Beyond high school	9	9	0.06	0.97
High school	25	24		
Below high school	11	12		
Bladder outlet obstruction (n, %)				
Yes	35	36	0.07	0.80
No	10	9		
Clinical Stages (n, %)				
T1c	24	25	0.04	0.83
T2	21	20		
Smoking (n, %)				
Yes	28	30	0.19	0.66
No	17	15		
Drinking (n, %)				
Yes	20	21	0.04	0.83
No	25	24		
GS (n, %)				
≤7 scores	21	22	0.04	0.83
≥8 scores	24	23		
Marital Status (n, %)				
Married	35	36	0.61	0.74
Single	5	3		
Divorced	5	6		
Domicile Place (n, %)				
Non-local	1	2	0.34	0.56
Native	44	43		

BMI: Body Mass Index; GS: Gleason score.

doctor indwelt catheter (F18) and prepared laparoscopic channel. The extra-peritoneal pneumoperitoneum pressure was maintained as 13 mmHg. Doctor incised the skin, dissected subcutaneous tissue and pubis and moved peritoneum with fingers to locate pubic bladder, puboprostatic ligament and bilateral pelvic fascia. The adipose tissues of anterior prostate were removed. The puboprostatic ligaments were separated from pelvic fascia and sutured with the prostate dorsal vein complex. With vesical neck remaining open, the vesical neck and ductus deferens were severed, and seminal vesicles were dissociated. The posterior layer of Denonvillier's fascia was longitudinally opened. The prostate fascia and intrapelvic fascia of prostate were freed to the prostate tip. Prostatic ligament and vascular pedicle were severed with Hem-o-lok clamp. The bilateral neurovascular bundles were retained to maximum extent. Ventral, dorsal, and bilateral tracts of prostate were dissociated. The prostate dorsal vein complex was dissociated and sutured through prostate surface, and urethra was completely dissociated with sufficient remaining length. Urethra near the prostate tip was sharply severed with scissors. The prostate tissue and seminal vesicles were completely removed. Confirming that rectum was intact, doctor anastomosed the urethra and bladder and replaced F15 with two-way Foley catheter (F20). Doctor injected 200 mL normal saline through catheter after the anastomosis and verified about no urine or anastomotic leakage. Doctor then injected 15 mL water through the bags. Finally, the indwelt drainage tube was observed in pelvic cavity to prevent infection.

2.2.2 Research group

Modified extraperitoneal total intrafascial laparoscopic radical prostatectomy was employed to treat patients in research

group. They were under local anesthesia regarding pubic bladder, puboprostatic ligament and bilateral pelvic fascia. The puboprostatic ligaments were not incised and prostate dorsal vein complex was not sutured. The ductus deferens and seminal vesicles were severed and dissociated. The vesical neck was severed with vesical neck remaining open. Denonvillier's fascia was fully reserved. Moreover, the interfascial tissues and bilateral prostate fascia were bluntly separated. The prostate fascia was incised to the top at 9 o'clock and 3 o'clock positions, and bilateral neurovascular bundles were reserved. Absorbable sutures were employed for suture and hemostasis. The dorsal and bilateral tracts of prostate were dissociated. The prostate dorsal vein complex was dissociated from the top along prostate ventral surface. The urethra near prostate tip was sharply severed with scissors, and prostate tissue and seminal vesicles were removed. Doctor confirmed the rectum being intact and no anastomotic leakage on bladder neck and urethra. Doctor then sutured the prostate dorsal vein complex, pubic bladder, puboprostatic ligament, bilateral pelvic fascia and antetheca of bladder neck with 3-0 barbed line. The front lift system was thus anatomically reconstructed. The indwelt drainage tube in pelvic cavity was observed after the operation to prevent infection.

2.3 Indicators

The operation, drainage, and hospitalization times, bleeding volume, vascular endothelial stimulation index, urinary continence, erectile function, complications, and recurrence were monitored and compared.

(1) Urinary continence: Doctor observed whether patients would use urinal pad. Patients with normal urinary control function did not use urinal pad.

(2) Erectile function: International Index of Erectile Function-5 was adopted. Patient with 21 out of 25 had normal erectile function.

(3) Vascular endothelial stimulation index: Serum samples from patients were taken. VEGF and IGF-I were determined by enzyme-linked immunosorbent assay (ELISA). Test kit was procured from Huarui Biotechnology Co., LTD. Test procedures were accomplished according to manufacturer's instructions.

(4) Prostate symptom: International Prostate Symptom Score (IPSS) was used having 35 points in total. More serious prostate symptoms were linked with higher score.

(5) Complications

Bladder irritation: Main indications were frequent urination, urgent urination and odynuria.

Normal person urinates 4~6 times in the day and 0~2 times at night on average. Urination exceeding 8 times is categorized as frequent urination. Urgent urination refers to the strong need to urinate. Odynuria is the burning or stabbing pain in bladder area and urethral orifice during urination.

2.4 Statistics

The data were statistically processed by SPSS 23.0 (IBM, Armonk, NY, USA), and enumeration data were presented as n and %. χ^2 test was conducted for comparing the two groups. Metering data were represented as $\bar{x} \pm s$. t-test was used for the comparison. $p < 0.05$ indicated significant difference.

3. Results

3.1 Comparison of clinical indexes

There were no significant differences in the clinical indexes of two groups. Details are given in Table 2.

3.2 Comparison of IEF-5 and IPSS

There was no significant difference before the treatment in scores of IEF-5 (International Index of Erectile Function) and IPSS (International Prostate Symptom Score) for two groups. After the treatment, IEF-5 scores were higher and IPSS were lower for the patients in research group than those in control. The difference was significant ($p < 0.05$). Details are found in Table 3.

3.3 Comparison of tumor markers

There was no significant difference in PSA (Prostate-specific Antigen) and CEA (Carcinoma Embryonic Antigen) for the two groups before treatment. After treatment, PSA and CEA of patients in research group were higher than those in control. The difference was significant ($p < 0.05$). Details are provided in Table 4.

3.4 Vascular endothelial stimulation index

There was no significant difference in VEGF and IGF-I for the two groups before operation. Three and seven days after operation, VEGF and IGF-I of research group were lower than those in control, and differences were significant ($p < 0.05$). Details are provided in Table 5.

3.5 Comparison of urinary continence index

Patients in research group with normal urinary function were more than in control after one and three months of operation, and difference was significant ($p < 0.05$). Details are provided in Table 6.

3.6 Comparison of erectile function indexes

Patients in research group with normal erectile function were more than in control after one and three months of operation, and difference was significant ($p < 0.05$). More details are provided in Table 7.

3.7 Comparison of incidence of complications

The incidence of complications in research group was 4.44%, lower than 17.78% of control. The difference was significant ($p < 0.05$). Details are provided in Table 8.

4. Discussion

Studies [9, 10] have found that it is difficult to avoid urinary complications such as bladder irritation, erectile dysfunction and urinary incontinence after the operation of localized prostate cancer patients, however, the postoperative patients'

TABLE 2. Comparison of clinical indexes ($\bar{x} \pm s$).

Group	N	Operation time (min)	Intraoperative blood loss (mL)	Postoperative drainage time (d)	Postoperative preserved time of indwelling catheter (d)	Length of stay (d)
Research group	45	99.35 ± 8.34	90.33 ± 9.61	6.82 ± 0.65	18.33 ± 1.22	8.16 ± 0.64
Control group	45	99.64 ± 7.96	89.67 ± 9.06	6.78 ± 0.60	18.44 ± 1.34	8.18 ± 0.61
t value	—	0.17	0.34	0.30	0.41	0.15
p value	—	0.87	0.74	0.76	0.68	0.88

TABLE 3. Comparison of IEF-5 and IPSS scores ($\bar{x} \pm s$).

Group	N	IEF-5 scores		IPSS scores	
		Before operation	After operation	Before operation	After operation
Research group	45	17.85 ± 1.69	13.52 ± 1.05	24.35 ± 2.16	4.35 ± 0.51
Control group	45	17.91 ± 1.71	11.25 ± 1.41	24.41 ± 2.21	6.38 ± 0.64
t value	—	0.17	8.66	0.13	16.64
p value	—	0.87	< 0.001	0.90	< 0.001

IPSS: International Prostate Symptom Score; IEF-5: International Index of Erectile Function.

TABLE 4. Comparison of tumor markers ($\bar{x} \pm s$).

Group	N	PSA (μg/L)		CEA (μg/L)	
		Before operation	After operation	Before operation	After operation
Research group	45	50.35 ± 5.16	32.06 ± 3.16	7.23 ± 0.65	4.25 ± 0.56
Control group	45	50.42 ± 5.09	40.61 ± 4.01	7.21 ± 0.59	5.56 ± 0.61
t value	—	0.06	11.23	0.15	10.61
p value	—	0.95	< 0.001	0.88	< 0.001

PSA: Prostate-specific Antigen; CEA: Carcinoma Embryonic Antigen.

TABLE 5. Vascular endothelial stimulation indexes ($\bar{x} \pm s$).

Group	N	VEGF (ng/mL)			IGF-I (ng/mL)		
		Before operation	3 days after operation	7 days after operation	Before operation	3 days after operation	7 days after operation
Research group	45	169.25 ± 14.35	185.35 ± 13.25	109.65 ± 9.31	201.35 ± 15.36	211.35 ± 16.35	136.35 ± 13.65
Control group	45	169.56 ± 13.24	226.35 ± 19.55	136.53 ± 9.98	202.16 ± 16.35	226.35 ± 14.95	164.35 ± 16.35
t value	—	0.11	11.65	13.21	0.24	4.54	8.82
p value	—	0.92	< 0.001	< 0.001	0.81	< 0.001	< 0.001

VEGF: vascular endothelial growth factor; IGF-I: insulin-like growth factor I.

TABLE 6. Comparison of urinary continence indexes (n, %).

Group	N	1 month after operation	3 months after operation	6 months after operation
Research group	45	33, 73.33	40, 88.89	45, 100.00
Control group	45	23, 51.11	32, 71.11	44, 97.78
χ^2 value	—	4.73	4.44	1.01
p value	—	0.03	0.04	0.31

TABLE 7. Comparison of erectile function indexes (n, %).

Group	N	1 month after operation	3 months after operation	6 months after operation
Research group	45	11, 24.44	23, 51.11	36, 80.00
Control group	45	4, 8.89	12, 26.67	31, 68.89
χ^2	—	3.92	5.66	1.46
p value	—	0.05	0.02	0.23

TABLE 8. Comparison of incidence of complications (n, %).

Group	N	Bladder irritation	Anastomotic fistula	Ureteral injury	Urinary fistula	Urinary incontinence	Total
Research group	45	1, 2.22	1, 2.22	0, 0.00	0, 0.00	0, 0.00	2, 4.44
Control group	45	2, 4.44	2, 4.44	2, 4.44	1, 2.22	1, 2.22	8, 17.78
χ^2	—			—			4.05
p value	—			—			0.04

survival can be prolonged by improving the clinical cure rates. This is one of the methods to improve tumor control outcomes while ensuring the patients normal erectile function and urinary continence. Clinical cases [11–13] have shown that extraperitoneal laparoscopic radical prostatectomy is often used on localized prostate cancer patients, and intrafascial laparoscopic radical prostatectomy preserves most periprostatic structures [14]. In this study, the modified total intrafascial radical prostatectomy was more effective in research group patients for recovering erectile dysfunction and urinal incontinence after operation.

The results show that modified total intrafascial radical prostatectomy has similar clinical effects as those by the conventional interfascial neurovascular bundles preservation surgery. Clinical studies have found that this method does not increase the risk of cancer cells on incisal margins linked to tumor and lesion control because of the complete removal of seminal vesicle and prostate gland [15–17]. Data after one to three months of operation exhibit that patients in research group have higher recovery rates from erectile dysfunction and urinary incontinence compared to the control. This proves that modified extraperitoneal total intrafascial laparoscopic radical prostatectomy has better effects and advantages in maintaining urodynamics [13, 18]. There are several reasons [19–22]: firstly, bilateral pelvic fascia was not opened during the operation, and doctor bluntly separated the bilateral prostate envelop only from fascia tissues, so that the bottom fascia was undamaged and bilateral neurovascular bundles were reserved, minimizing the damage to pelvic muscles such as levator ani, and controlled the damage to erectile function and urinary continence. Secondly, the internal urethral sphincter and bladder neck were preserved to maximum extent because of complete removal of tumor cells, which provided environment for the recovery from erectile dysfunction and urinary incontinence. Thirdly, the prostate top was dissociated from inner part of fascia which reduced damage to urethral sphincter and accelerated the patients' recovery [23]. Fourthly, Denonvillier's fascia was completely preserved which benefited from the integrity of supporting structure behind urethra, and created favorable conditions for urodynamics recovery. Fifthly, the urethra length was sufficient and anatomic reconstruction of front lift system preserved the surrounding structures, which was the basic condition for recovery. Sixthly, the prostate dorsal vein complex was not sutured, and puboprostatic ligament or pubic bladder was retained during the intrafascial dissociation, so that the front lift system was statically maintained [24]. Thus, the results had proved that modified extraperitoneal total intrafascial laparoscopic radical prostatectomy had better effects than conventional interfascial neurovascular bundle preservation surgery.

Patients have different kinds of postoperative effects as the operation stimulates vascular endothelium [25, 26]. VEGF is the key index to reflect damage which increases with more vascular endothelial stimulation. IGF-I is expressed and secreted in interstitial cells and enter blood after vascular endothelial injury. More IGF-I indicates more serious vascular endothelial stimulation [27]. The results showed that upon comparing the data of serum VEGF after 3 and 7 days of operation, IGF-I levels were increased at the beginning and then decreased. The control group levels were higher than those of research group which proved that stimulation of modified extraperitoneal laparoscopic total intrafascial radical prostatectomy was more serious. Reason might be the superficial sutures with absorbable lines when performing modified extraperitoneal laparoscopic total intrafascial radical prostatectomy, so that thermal damage by electrocoagulation or ultrasonic knife to peripheral structures and blood vessels was reduced. At the same time, blunt dissection method was used to separate fascia from prostate envelop for reducing the damage to neurovascular bundles. Thus, intrafascial resection reduced the traumatic stimulation caused by the operation [28–30].

5. Conclusions

In summary, the modified extraperitoneal laparoscopic total intrafascial radical prostatectomy reduces the degree of traumatic stimulation on prostate cancer patients during operation, improves postoperative urinary continence and erectile function, and reduces the incidence of complications, which is thus

worthy of clinical promotion and application. However, the selected cases in this study have limitations, such as single source of patients, insufficient sample size, and short follow-up time. In future, the clinical effectiveness of modified extraperitoneal laparoscopic total intrafascial radical prostatectomy can be expanded, and its long-term efficacy be further confirmed.

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 corresponding author upon request.

AUTHOR CONTRIBUTIONS

DY and KL—designed the study and performed; DY, KL, YW, LH, MSW and KJ—supervised data collection, data analysis, data interpretation, and preparation of manuscript for publication, and reviewed the manuscript draft. All authors have read and approved the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from Ethics Committee of 363 Hospital (Approval No. 2020002). Written informed consent was obtained from legally authorized representative for anonymized patient information to be published in this article.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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How to cite this article: Dan Yuan, Kang Li, Yu Wang, Long Huang, Mingsong Wang, Kang Jia. Effect of modified extraperitoneal laparoscopic total intrafascial radical prostatectomy on clinical efficacy for prostate cancer patients. Journal of Men's Health. 2023; 19(7): 86-92. doi: 10.22514/jomh.2023.060.