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Analysis of Influencing Factors of Hospitalization Time of Patients After Laparoscopic Extraperitoneal Radical Prostatectomy

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Abstract: *Backgrounds:* Prostate cancer is the second highest cause of malignant tumors in men worldwide, extraperitoneal laparoscopic radical prostatectomy (ELRP) was widely used in the treatment of localized prostate cancer. This study explored the factors affecting the length of stay in patients after ELRP. *Methods:* We performed a retrospective analysis of the clinical data of 209 patients undergoing ELRP between January 2019 and December 2020. The multiple linear regression analysis model was used to analyze the factors that influenced hospital stay in patients after ELRP. *Results:* The median postoperative hospital stay was 9 days. Univariate regression analysis found that postoperative complications, the presence or absence of blood product transfusion, and postoperative indwelling catheter time were correlated to a postoperative hospital stay ($P < 0.05$). After adjusting for other variables, multivariate regression analysis found that a history of drinking, preoperative PSA value of 10-20 μg/L, postoperative complications of anastomotic leakage, and postoperative indwelling catheter time were independent risk factors related to delayed discharge ($P < 0.05 \sim P < 0.0001$). *Conclusion:* The length of hospital stay after ELRP was affected by many factors. Low-level preoperative PSA values, avoiding complications of anastomotic leakage, and timely removal of catheters have the potential to shorten the hospital stay after ELRP. The high-risk groups should regularly check the serum PSA value to optimize the utilization of medical resources, and physicians should strive to improve intraoperative surgical techniques, reduce postoperative complications, and remove catheters in time.

Keywords: Laparoscopic Extraperitoneal, Radical Prostatectomy, Length of Hospital Stay

1. Introduction

Currently, prostate cancer is the second highest cause of malignant tumors and is the fifth leading cause of cancer-related fatalities in men worldwide. In China, the incidence of prostate cancer is the highest among the malignant tumors of the male urinary tract and reproductive system, higher than that of bladder cancer [1, 2]. In 1997, extraperitoneal laparoscopic radical prostatectomy (ELRP) was reported by Raboyd et al [3] and is now widely used in the treatment of localized prostate cancer [4]. In recent years, hospitalizationtime is being increasingly used as an indicator to measure the consumption of medical resources [5, 6]. Long-term hospitalizationtime is not only related to higher medical expenses and resource consumption [7] but also might increase the risk of complications, including hospital-acquired infections and deep vein thrombosis [8, 9].

Currently, there are many risk factors associated with prolonged hospital stay under laparoscopic surgery in urology, including preoperative, intraoperative factors, and postoperative complications [10]. However, the relationship between disease-specific variables and patient clinical indicators and the short-term prognosis after ELRP is unclear. Therefore, here, we analyzed various preoperative clinical indicators, perioperative conditions, and complications from postoperative to the discharge of prostate cancer patients undergoing ELRP. We

explored the possible risk factors of delayed discharge after ELRP to provide clinical ideas for the prediction and evaluation of the short-term prognosis after ELRP.

2. Material and Methods

2.1. General Information

This retrospective cohort study included 209 patients with prostate cancer who underwent ELRP in our department between January 2019 and December 2020. This study was approved by the Ethics Committee of The First Affiliated Hospital of Wenzhou Medical University (approval number: 2019-024-01) and was conducted in accordance with the Declaration of Helsinki. All participants were informed about the purpose of the study and signed the informed consent.

The inclusion criteria were as follows: (1) Clinical and pathological confirmation of prostate cancer diagnosis; (2) Preoperative imaging examination to exclude distant and/or systemic metastases; (3) Complete basic clinical data; (4) ELRP was performed.

The exclusion criteria were as follows: (1) Patients who underwent neoadjuvant endocrine therapy or chemotherapy before surgery; (2) Patients who underwent prostatectomy or bladder tumors before surgery; (3) Patients with other tumors; (4) Patients who were converted to open surgery during the operation.

2.2. Data Collection

We collected the following information on the research subjects: (1) General information, such as hospitalization number, age, body mass index (BMI), smoking history, drinking history; (2) Medical history, such as the history of hypertension, diabetes, and other cardiovascular and cerebrovascular diseases; (3) Preoperative laboratory data, such as serum albumin, hemoglobin, white blood cells, red blood cells, and other indicators. Groups were grouped based on the normal range value of laboratory inspection.

The collected preoperative prostate-specific antigen (PSA) values, clinical staging, and pathological Gleason scores of preoperative biopsy specimens were classified according to the D'Amico prostate cancer risk factor classification method. Preoperative PSA was divided into three groups, namely < 10 μg/L, 10-20 μg/L, > 20 μg/L. The most recent PSA value before the prostate biopsy was used in the analysis. The preoperative clinical staging was divided into three groups, namely ≤cT2b, cT2c, ≥cT3a. The clinical staging was mainly determined based on the results of puncture pathology, magnetic resonance imaging (MRI), and digital rectal examination and was divided according to the 8th edition of the American Joint Committee on Cancer (AJCC) cancer staging standard [11]. The pathological Gleason scores of preoperative biopsy specimens were divided into three groups as follows: ≤ 6 points, 7 points, and ≥8 points. The pathological specimens after ELRP included the proportion of tumors, postoperative margins, prostate tumor invasion, and tumor metastasis.

The perioperative conditions, such as the operation time, the time of the first meal after the operation, any transfusion of blood products, such as transfusion of plasma, suspended red blood cells, platelets, and albumin was also recorded. Postoperative complications, such as anastomotic leakage, postoperative infection, etc., as well as postoperative hospital stay and indwelling catheter time, were also recorded.

According to the study by Shan et al [12], postoperative infections were divided into incision infection, lower urinary tract infection, and lung infection. Incision infection referred to infection of the skin and subcutaneous tissue around the incision within 1 month after the operation, and was identified if the incision was swollen and painful, or there was purulent discharge. Postoperative anastomotic leakage was based on the similarity between the creatinine value of pelvic drainage and urine creatinine at 24 hours postoperatively [13]. The postoperative hospital stay was calculated based on the number of days from the day of surgery to the time of discharge from the hospital.

2.3. Statistical Analysis

Continuity variables were first tested for normality. Those conforming to the normal distribution were represented by, and those not conforming to the normal distribution were represented by the median and interquartile range numbers. Categorical variables were expressed by the number of cases (%). First, single factor regression analysis was used to determine potential risk factors, and multivariate regression analysis was used to determine independent risk factors for a postoperative hospital stay. Statistical analysis used R (http://www.r-project.org; version 3.4.3) and SPSS25.0 statistical software. $P<0.05$ indicated a statistically significant difference.

3. Results

3.1. General Information of the Patient and Description of the Perioperative Situation

The operation of 209 patients in this group was completed under laparoscopy, and none of the cases were transferred to open surgery. Postoperative pathology confirmed that they were all prostate cancer. The patients were aged 50-81 years, with an average of 67.80 ± 6.72 years. The preoperative clinical stage was 29 cases (13.88%) in the cT2b group, 75 cases (35.89%) in the cT2c group, and 105 cases (50.24%) in the cT3a group. The preoperative PSA ranged from 0.611-293.52 μg/L, 72 cases (35.12%) in the < 10 μg/L group, 64 cases (31.22%) in the 10-20 μg/L group, and 69 cases (33.66%) in the > 20 μg/L group. The patient's BMI value was 18.6-31.6 kg/m^2, with an average of 24.12 ± 2.62 kg/m^2. The average operation time of patients was 248.30 ± 50.53 min. The postoperative fasting time was 1-3 d, the postoperative hospital stay was 4-40 d, the median was 9.00 d, and the catheter removal time was 18.26 ± 6.01 d. Seventy-five patients had surgery-related complications after surgery. Anastomotic leakage occurred in 29 cases (13.88%) after the operation. After re-adjusting the placement of the urinary catheter, the continuous urinary catheter was tracted with a smaller tension so that the drainage tube behind the pubic bone was drained without obstruction, and the infection prevention

and other conservative treatments were improved after 3-8 days. Also, 46 cases (21.05%) had postoperative infections. These patients improved and were discharged after 7-14 d of dressing change and anti-infection treatment (Table 1).

Table 1. *Description of patients' general information.*

Variables	Mean (SD)/ Median (Q1-Q3)
Age	67.80 (6.72)
Operation time/min	248.30 (50.53)
BMI/(kg/m²)	24.12 (2.62)
Indwelling catheter time/day	18.26 (6.01)
White blood cells (*10^9/L)	6.26 (1.64)
Hospitalization expenses (ten thousand yuan)	4.07 (0.85)
Postoperative hospital stay/day	9.00 (7.00-13.00)
Preoperative hemoglobin (g/L)	140.04 (13.63)
Preoperative serum albumin (g/L)	41.01 (4.24)
Drinking [Example (%)]	
No	120 (57.42%)
Yes	89 (42.58%)
Smoking [cases (%)]	
No	118 (56.46%)
Yes	91 (43.54%)
History of hypertension [cases (%)]	
No	105 (50.24%)
Yes	104 (49.76%)
History of diabetes [cases (%)]	
No	166 (79.43%)
Yes	43 (20.57%)
History of cardiovascular and cerebrovascular diseases [cases (%)]	
No	185 (88.52%)
Yes	24 (11.48%)
Anastomotic leakage of urine [case (%)]	
No	180 (86.12%)
Yes	29 (13.88%)
Blood transfusion products [Example (%)]	
No	165 (78.95%)
Yes	44 (21.05%)
Postoperative infection [cases (%)]	
No	165 (78.95%)
Yes	44 (21.05%)
Margin situation [Example (%)]	
-	139 (66.51%)
+	70 (33.49%)
With or without transfer [example (%)]	
No	180 (86.12%)
Yes	29 (13.88%)
Clinical stage [cases (%)]	
≤T2a	29 (13.88%)
T2a	75 (35.89%)
≥T2c	105 (50.24%)
Preoperative PSA value (μg/L) [cases (%)]	
<10	72 (35.12%)
10-20	64 (31.22%)
>20	69 (33.66%)
Biopsy Gleason score [cases (%)]	
≤6	35 (16.83%)
7	101 (48.56%)
≥8	72 (34.62%)

3.2. Single-Factor Analysis of Influencing Factors of Hospital Stay After ELRP

Univariate analysis found that postoperative indwelling catheter time, postoperative anastomotic leakage, postoperative infection, and postoperative blood product transfusion were significant factors influencing the length of hospital stay after ELRP (P<0.0001). (Table 2).

Table 2. *Single-factor analysis of influencing factors of hospital stay after ELRP.*

Variables	Statistics	β value	95%CI	P
Age	67.80±6.72	0.04	(-0.10, 0.17)	0.5783
BMI/(kg/m²)	24.12±6.72	-0.03	(-0.38, 0.31)	0.8439
Indwelling catheter time/day	18.26±6.01	0.62	(0.50, 0.75)	<0.0001
White blood cells (*10^9/L)	6.26±1.64	-0.46	(-1.01, 0.09)	0.1007
Preoperative hemoglobin (g/L)	140.04±13.63	-0.04	(-0.11, 0.02)	0.1950
Preoperative serum albumin (g/L)	41.01±4.24	0.14	(-0.08, 0.35)	0.2152
Drinking [Example (%)]				
No	120 (57.42%)	Ref		
Yes	89 (42.58%)	-0.33	(-2.16, 1.51)	0.7274
Smoking [cases (%)]				
No	118 (56.46%)	Ref		
Yes	91 (43.54%)	-0.23	(-2.06, 1.60)	0.8069
History of hypertension [cases (%)]				
No	105 (50.24%)	Ref		
Yes	104 (49.76%)	0.63	(-1.18, 2.45)	0.4955
History of diabetes [cases (%)]				
No	166 (79.43%)	Ref		
Yes	43 (20.57%)	-0.84	(-3.09, 1.40)	0.4616
History of cardiovascular and cerebrovascular diseases [cases (%)]				
No	185 (88.52%)	Ref		
Yes	24 (11.48%)	0.12	(-2.73, 2.97)	0.9345
Anastomotic leakage of urine [case (%)]				
No	180 (86.12%)	Ref		
Yes	29 (13.88%)	9.51	(7.22, 11.79)	<0.0001
Blood transfusion products [Example (%)]				
No	165 (78.95%)	Ref		
Yes	44 (21.05%)	4.35	(2.21, 6.50)	<0.0001
Postoperative infection [cases (%)]				
No	165 (78.95%)	Ref		
Yes	44 (21.05%)	5.19	(3.11, 7.26)	<0.0001
Margin situation [Example (%)]				
-	139 (66.51%)	Ref		
+	70 (33.49%)	0.23	(-1.69, 2.15)	0.8157
With or without transfer [example (%)]				
No	180 (86.12%)	Ref		
Yes	29 (13.88%)	-0.1	(-2.73, 2.52)	0.9392
Clinical stage [cases (%)]				
≤T2a	29 (13.88%)	Ref		
T2a	75 (35.89%)	1.84	(-1.02, 4.71)	0.2088
≥T2c	105 (50.24%)	0.85	(-1.90, 3.60)	0.5449
Preoperative PSA value (μg/L) [cases (%)]				
<10	72 (35.12%)	Ref		
10-20	64 (31.22%)	2.03	(-0.22, 4.28)	0.0787
>20	69 (33.66%)	0.58	(-1.62, 2.79)	0.6043
Biopsy Gleason score [cases (%)]				
≤6	35 (16.83%)	Ref		
7	101 (48.56%)	1.31	(-1.26, 3.87)	0.3184
≥8	72 (34.62%)	2.47	(-0.22, 5.16)	0.0737

Ref is the reference category.

Table 3. *Multiple linear regression analysis of factors affecting hospital stay after ELRP.*

Variables	Statistics	β value	95%CI	P
Age	67.80±6.72	-0.05	(-0.15, 0.06)	0.3692
BMI/(kg/m²)	24.12±6.72	-0.03	(-0.28, 0.23)	0.8375
Indwelling catheter time/day	18.26±6.01	0.31	(0.18, 0.43)	<0.0001
White blood cells (*10^9/L)	6.26±1.64	-0.39	(-0.78, 0.01)	0.0561
Preoperative hemoglobin (g/L)	140.04±13.63	-0.03	(-0.09, 0.02)	0.2137
Preoperative serum albumin (g/L)	41.01±4.24	0.14	(-0.03, 0.31)	0.1040
Drinking [Example (%)]				
No	120 (57.42%)	Ref		
Yes	89 (42.58%)	-1.41	(-2.80, -0.02)	0.0491
Smoking [cases (%)]				
No	118 (56.46%)	Ref		
Yes	91 (43.54%)	0.49	(-0.92, 1.90)	0.4967

Variables	Statistics	β value	95%CI	P
History of hypertension [cases (%)]				
No	105 (50.24%)	Ref		
Yes	104 (49.76%)	0.25	(-1.10, 1.61)	0.7134
History of diabetes [cases (%)]				
No	166 (79.43%)	Ref		
Yes	43 (20.57%)	-0.58	(-2.23, 1.06)	0.4900
History of cardiovascular and cerebrovascular diseases [cases (%)]				
No	185 (88.52%)	Ref		
Yes	24 (11.48%)	0.68	(-1.43, 2.78)	0.5309
Anastomotic leakage of urine [case (%)]				
No	180 (86.12%)	Ref		
Yes	29 (13.88%)	4.9	(2.67, 7.13)	<0.0001
Blood transfusion products [Example (%)]				
No	165 (78.95%)	Ref		
Yes	44 (21.05%)	0.32	(-1.39, 2.02)	0.7163
Postoperative infection [cases (%)]				
No	165 (78.95%)	Ref		
Yes	44 (21.05%)	0.62	(-1.06, 2.30)	0.4701
Margin situation [Example (%)]				
-	139 (66.51%)	Ref		
+	70 (33.49%)	0.03	(-1.57, 1.63)	0.9728
With or without transfer [example (%)]				
No	180 (86.12%)	Ref		
Yes	29 (13.88%)	-1.11	(-3.19, 0.96)	0.2940
Clinical stage [cases (%)]				
≤T2a	29 (13.88%)	Ref		
T2a	75 (35.89%)	0.1	(-1.90, 2.10)	0.9189
≥T2c	105 (50.24%)	-0.29	(-2.47, 1.89)	0.7942
Preoperative PSA value (μg/L) [cases (%)]				
<10	72 (35.12%)	Ref		
10-20	64 (31.22%)	2.21	(0.63, 3.79)	0.0069
>20	69 (33.66%)	1.48	(-0.23, 3.19)	0.0922
Biopsy Gleason score [cases (%)]				
≤6	35 (16.83%)	Ref		
7	101 (48.56%)	0.64	(-1.19, 2.48)	0.4924
≥8	72 (34.62%)	0.24	(-1.86, 2.34)	0.8210

Ref is the reference category.

3.3. Multiple Linear Regression Analysis of Factors Affecting Hospitalization Time After ELRP

The results of the multivariate analysis confirmed that drinking history, postoperative anastomotic leakage, indwelling catheter time, preoperative PSA 10-20 μg/L were independent factors influencing the length of hospital stay after ELRP (P<0.05 ~ P<0.0001). Among them, the preoperative blood PSA value between 10-20 μg/L was positively correlated to the postoperative hospital stay (β = 2.21). However, when the blood PSA value was > 20 μg/L or less than 10 μg/L, the postoperative hospital stay was not significant. (Table 3).

4. Discussion

The 2020 Global Cancer Statistics Report showed that prostate cancer was the most common cancer among men in 107 out of 185 countries around the world. The incidence of prostate cancer among Chinese men ranks sixth [14]. As an important indicator of resource utilization, hospitalization time is commonly used as it represents a limited medical resource and increasing pressure of cost control [10, 15]. The need to shorten the length of hospital stay after surgery and reduce the financial burden of patients is vital. Therefore, clarifying the risk factors that are significantly related to prolonged hospital stay can help doctors identify high-risk patients and formulate corresponding plans to shorten the hospital stay and reduce postoperative complications and the economic expenses of patients in the hospital.

In this study, 209 patients with prostate cancer were treated with ELRP, which has the advantages of shortening the operation time, postoperative hospital stay, and reducing perioperative complications [16]. We found that people with a history of drinking, preoperative blood PSA between 10-20 μg/L, postoperative anastomotic leakage, and postoperative indwelling catheter time were important influencing factors for the prolonged hospital stay after ELRP. Compared with patients with preoperative PSA of less than 10 μg/L, patients with preoperative PSA of 10-20 μg/L had an increased average hospital stay by 2.21 days. The postoperative hospital stay in the postoperative anastomotic leakage complications group was 4.9 days longer than that in the non-urinary leakage complications group, and the length of hospital stay increased by 0.31 days for every day of postoperative indwelling catheter time.

Analysis of Factors Affecting the Length of Hospitalization After ELRP

PSA value before surgery:

PSA is a glycoprotein in the kallikrein family, which is mainly synthesized by prostate acinar and ductal epithelial cells. It is currently one of the reliable tumor markers for diagnosing prostate cancer and assessing its prognosis [17]. In addition, prostate cancer has the characteristics of insidious onset and unclear clinical symptoms. Therefore, it is necessary to expand the scope of the population for early screening of prostate cancer. High-risk groups should check their blood PSA value regularly, especially for patients whose blood PSA value is > 10 μg/L after being diagnosed by a prostate biopsy. In a previous study, the Gleason score evaluation of disease-specific variables was not found to be significant, which was similar to the results of our study [18]. However, there were a few studies on the effect of prostate cancer disease-specific risk factors on the length of stay in patients after ELRP. Further prospective studies are needed to verify the importance of preoperative PSA as a predictor of prolonging the postoperative hospital stay.

Postoperative anastomotic leakage and indwelling catheter time:

Postoperative anastomotic leakage is one of the common complications after ELRP. Zong Shouwei [19] believed that ELRP had the advantages of reducing postoperative anastomotic leakage and shortening the time of postoperative indwelling catheters during the treatment of prostate cancer. Therefore, doctors should carefully dissect the apex of the prostate during the operation and pay attention to protecting the urinary control nerve and the deep dorsal penile venous plexus to anastomose the urethra and bladder to reduce postoperative anastomotic leakage and shorten the time of catheterization [20]. Zhang [21] also confirmed through research that doctors' surgical experience and skills were favorable predictors of perioperative complications. In addition, in the refined care of patients after ELRP, attention needs to be paid toward the nature and amount of patient drainage, and the care of catheters should be enhanced to prevent postoperative infections, which can reduce the complications of patients with anastomotic leakage [22]. In addition, the time of indwelling catheters could be shortened, thereby shortening the postoperative hospital stay.

Previous studies [23] and other related studies [16, 24] have found that intraoperative variables, such as operation time are also significantly related to a postoperative hospital stay. However, our research results showed that operation time was not a significant predictor of postoperative hospital stay, which was probably related to the increasing maturity and standardization of ELRP surgery.

However, our research also has certain limitations. First, this was a retrospective analysis, and selection bias was inevitable. Second, our data came from a single center, and a large sample study of multiple centers is still needed to verify our results. Thus, further analysis and clarification of the risk factors for prolonged hospital stay after ELRP would help evaluate the postoperative recovery of patients and more effective medical resource management.

5. Conclusion

In summary, Through our preliminary research, it has been shown that prostate-specific indicators, preoperative clinical indicators, and postoperative complications might be important predictors of prolonged hospital stay after ELRP. Thus, in response to these indicators, prostate cancer screening, and the related surgical experience and technology needs to be improved. In addition, strengthening the care of postoperative patients is conducive to reducing postoperative complications, shortening the length of hospitalization, and improving the efficiency of medical resources utilization.

Author Contributions

Xixi Hu: Conceptualization; data curation; funding acquisition; investigation; methodology; project administration; writing-original draft; writing-review and editing. Dongdong Yu: Data curation; investigation; methodology; project administration; writing-review and editing. Haiyan Li: Conceptualization; data curation; investigation; writing-review and editing. Changyun Chen: Data curation; writing-review and editing. Hai-Hong Jiang: Conceptualization; data curation; funding acquisition; investigation; methodology; project administration; writing-original draft; writing-review and editing.

Conflicts of Interest

All the authors do not have any possible conflicts of interest.

Data Sharing and Data Accessibility

Article data can be obtained by contacting the corresponding author.

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