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ORIGINAL ARTICLE

Prostate Cancer

The Institute of Urology, Peking University prostatectomy score: a simple preoperative classification of prostate cancer for predicting surgical difficulty and risk

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Traditional laparoscopic radical prostatectomy is a treatment choice in many developing countries and regions for most patients with localized prostate cancer; however, no system for predicting surgical difficulty and risk has been established. This study aimed to propose a simple and standard preoperative classification system of prostate cancer using preoperative data to predict surgical difficulty and risk and to evaluate the relationship between the data and postoperative complications. We collected data from 236 patients and divided them into three groups to evaluate and validate the relationships among preoperative, operative, and postoperative data. This new scoring system is based on the body mass index, ultrasonic prostate volume, preoperative prostate-specific antigen level, middle lobe protrusion, and clinical stage. In the scoring group, we classified 89 patients into two groups: the low-risk group (score of <4) and high-risk group (score of ≥4), and then compared the postoperative data between the two groups. The positive surgical margin rate was higher in the high-risk group than low-risk group. The results in validation Groups A and B were similar to those in the scoring group. The focus of our scoring system is to allow for preliminary assessment of surgical difficulty by collecting the patients' basic information. Urologists can easily use the scoring system to evaluate the surgical difficulty and predict the risks of a positive surgical margin and urinary incontinence in patients undergoing laparoscopic radical prostatectomy.

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Keywords: laparoscopic radical prostatectomy; prostate cancer; scoring system; surgical difficulty and risk

INTRODUCTION

The standard therapy for patients with localized prostate cancer is radical prostatectomy. Robot-assisted laparoscopic radical prostatectomy (RALP) has recently been a new choice for most cases of localized prostate cancer and is now routinely performed for such patients in many developed countries; however, traditional laparoscopic radical prostatectomy (LRP) is still important in many developing countries and regions.[1,2]

D'Amico *et al.*[3] classified patients with prostate cancer into three groups: low risk (stage T1c, T2a, and a prostate-specific antigen [PSA] level of ≤10 ng ml^{-1} and Gleason score of ≤6), intermediate risk (stage T2b or Gleason score of 7 or PSA level of >10 ng ml^{-1} and ≤20 ng ml^{-1}), and high risk (stage T2c or PSA level of >20 ng ml^{-1} or Gleason score of ≥8). They subsequently compared the biochemical outcome of different therapies among the three groups. However, surgical difficulty and risk were not easily predicted using this classification. Moreover, to the best of our knowledge, no classification describes the preoperative findings related to prostate cancer in a reproducible and quantifiable way. Thus, we designed a new system that utilizes simple and readily available preoperative data to predict surgical difficulty and risk.

This study was performed to (i) propose a simple and standard preoperative classification system for prostate cancer consisting of preoperative data for predicting surgical difficulty and risk and (ii) evaluate the relationship between the data and postoperative complications.

PATIENTS AND METHODS

Patient population

From August 2013 to April 2017, 236 consecutive patients underwent LRP. Of these patients, 177 underwent three-port extraperitoneal LRP (TELRP) and 59 underwent transperitoneal LRP (TLRP) by two of the authors (QZ and LQZ, respectively), both of whom have performed more than 1000 LRPs. None of the patients received neoadjuvant endocrine therapy. The study was adopted by the Ethics Committee of Peking University Health Science Center, Beijing, China, and all of patients had signed informed consent for this study.

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Several factors were included as preoperative data: age, height, weight, body mass index (BMI), diabetes, history of abdominal or pelvic surgery, preoperative PSA level, prostate volume on ultrasonic examination, presence of a median lobe, and clinical stage. Operative data, which included the operative time (OT) and estimated blood loss (EBL), represented the surgical difficulty. Postoperative data consisted of the positive surgical margin (PSM) rate, hospital length of stay (LOS), drainage duration (DD), overall expenditure (OE), and urinary continence recovery.

The Institute of Urology, Peking University (IUPU) prostatectomy scoring system is based on the five most reproducible preoperative data used to evaluate and predict surgical difficulty and risk by evaluating the relationships among preoperative, operative, and postoperative data. These data include the BMI, prostate volume on B-mode ultrasound, preoperative PSA level, presence of a large median lobe, and clinical stage. All 177 patients who underwent TELRP were randomly divided into two groups, and 89 patients were in the scoring group, while 88 patients were in the validation Group A. The patients who underwent TLRP comprised the validation Group B.

Surgical technique

TELRP is a new LRP technique developed by one of the authors (QZ). Briefly, a 3-cm incision was made at the level of the umbilicus, and dissection was carried out to the space created anterior to the posterior rectus sheath and underlying peritoneum. A balloon dilator device was inserted into the preperitoneal space; approximately 500 ml of air was inflated to develop the space of Retzius. A 10-mm trocar was placed below the umbilicus for insertion of a 30° endoscope. A 12-mm trocar and a 5-mm trocar were then placed lateral to the rectus muscle approximately two fingerbreadths below the umbilicus on the right and left sides, respectively (**Figure 1**). The extraperitoneal area was explored under optic vision, after establishing pneumo-extraperitoneum by carbon dioxide gas insufflation (maximum pressure, 14 mmHg; maximum gas flow, 30 ml s^{-1}).

The fatty and areolar tissues were gently swept from the endopelvic fascia and anterior surface of the bladder neck and prostate, respectively. The endopelvic fascia was incised with an ultrasonic scalpel, and the fibrous tissue between the apex of the prostate and the levator ani muscle was separated fully side by side. The puboprostatic ligament was dissected. A 15-cm barbed suture with a needle holder was used for ligation of the dorsal venous complex. The bladder neck was identified by either repeated pulling of the urinary catheter or palpation with the ultrasonic scalpel. A transverse incision was made, and dissections were then performed bilaterally in the plane between the prostate and bladder. Hemostasis was performed using a vessel-sealing device (VSD) without additional clips or sutures.

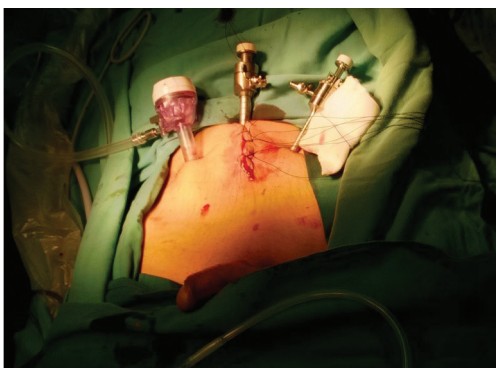

Figure 1: Positions of three trocars

The surgeon then exposed and disconnected the bilateral deferent ducts after dissection of the posterior bladder neck. The seminal vesicle arteries were mobilized and transected with the VSD. The lateral pedicles were also dissected with the VSD at the 3- and 9-o'clock positions. The posterior layer of Denonvilliers' fascia was opened horizontally. Blunt dissection down to the apex of the prostate was performed between the prostatic fascia and endopelvic fascia. After complete mobilization of the prostate, the urethra was separated and transected with the VSD at the apex of the prostate. The prostate was completely detached, inserted into a specimen bag, and removed via the subumbilical incision at the end of the operation. A running urethrovesical anastomosis using an absorbable barbed suture was performed. A retropubic drain was placed through the right lateral port. All trocars were removed and the skin wounds were closed.

None of the 236 patients underwent nerve preservation. None of 177 patients in the TELRP group underwent pelvic lymphadenectomy, while all 59 patients in the TLRP group underwent standard pelvic lymphadenectomy; however, none of them underwent extended regional lymph node dissection.

Statistical analysis

Parametric continuous variables are presented as mean ± standard deviation, and nonparametric continuous variables are presented as median and interquartile range (IQR). Analysis of variance and the Kruskal–Wallis test were used to evaluate the relationship between the preoperative and operative data for univariate analyses. Pearson's Chi-square test was used to compare the PSM and continence rates between the low-risk and high-risk groups. For all statistical analyses, a two-sided $P < 0.05$ was considered statistically significant. All data were analyzed using SPSS version 24.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The patients' baseline characteristics and perioperative outcomes are shown in **Table 1**. The IUPU prostatectomy score is based on the five most reproducible and pertinent variables that characterize patients with prostate cancer: BMI, prostate volume on B-mode ultrasound, preoperative PSA level, presence of a large median lobe, and clinical stage. The data in the scoring group were used to establish the scoring system.

The primary variable used to characterize a patient with prostate cancer is the BMI. In the present study, the patients were divided into two groups based on their BMI. In the 89 patients, 54 had lower BMI (<25 kg m^{-2}) and 35 had higher BMI (≥25 kg m^{-2}). The mean OT was significantly higher in patients with higher BMI ($P = 0.035$). However, the EBL was not significantly different between the two groups ($P = 0.728$). Thus, a score of 0 was assigned to patients with a BMI of <25 kg m^{-2}, whereas a score of 1 was assigned to those with a BMI of ≥25 kg m^{-2}.

The second variable is the prostate volume on B-mode ultrasound examination. In the 89 patients, 29 had lower volume on B-mode ultrasound (<30 ml) and 60 had higher volume (≥30 ml). Significant differences in both OT and EBL were found between the patients with lower prostate volume and those with higher volume ($P = 0.0001$ and 0.001, respectively). Thus, a score of 0 was assigned to patients with a prostate volume of <30 ml, and a score of 2 was assigned to those with a prostate volume of ≥30 ml.

The preoperative PSA level is the third factor influencing surgical difficulty and risks. Among the 89 patients, 32 had low PSA levels (<10 ng ml^{-1}) and 57 had high PSA levels (≥10 ng ml^{-1}). Increased

PSA levels were associated with significantly higher EBL ($P = 0.045$), but had no correlation with OT ($P = 0.079$). Patients with low PSA levels (<10 ng ml^{-1}) were assigned a score of 0, whereas those with high PSA levels (≥10 ng ml^{-1}) were assigned a score of 1.

Another variable to consider is the presence of a large median lobe. Among the 89 patients, 26 (29.2%) had an enlarged median lobe. The OT and EBL were significantly higher in patients with than without an enlarged median lobe ($P = 0.025$ and 0.023); thus, a score of 0 was assigned to patients with a small median lobe and a score of 2 was assigned to patients with a large median lobe.

The last factor is clinical stage. In scoring group, 20 patients had lower clinical stages (≤cT2b), while clinical stages of the other 69 patients were higher (>cT2b). Significant differences in EBL were found between the two groups ($P = 0.001$). Thus, patients with lower clinical stages were assigned a score of 0, while those with high clinical stages were assigned a score of 1 (**Table 2**).

The scoring system uses a scale ranging from 0 to 7. The low-risk group includes patients with scores of 0 to 3, and the high-risk group includes those with scores of 4 to 7 (**Table 3**).

According to our scoring system, 41 (46.1%) patients obtained scores of 0 to 3 and comprised the low-risk group, while 48 (53.9%) patients obtained scores of 4 to 7 and comprised the high-risk group. The data from the low- and high-risk groups were as follows: PSM rate, 12.2% (5/41) and 31.3% (15/48); median LOS, 4 (IQR: 3.5–5.5) and 4 (IQR: 4–5) days; median DD, 3 (IQR: 2–4) and 3 (IQR: 3–4) days; and median OE, 59548.50 (IQR: 52504.55–64323.18) and 55852.57 (IQR: 48549.41–61668.20) CNY. The PSM rate in the high-risk group was significantly higher than that in the low-risk group ($P = 0.032$). However, no significant difference in LOS, DD, or OE was found between the two groups ($P = 0.816$, 0.397, and 0.071, respectively).

We also compared another critical postoperative factor, urinary continence recovery, between the low-risk and high-risk groups. The median follow-up time was 25 (IQR: 14–32) months. The continence rates at 3, 6, and 12 months after LRP in the low-risk group were 37.0% (10/27), 66.7% (14/21), and 83.3% (15/18), respectively; those in the high-risk group were 47.1% (16/34), 67.6% (23/34), and 93.9% (31/33), respectively. Although the continence rates were higher in the high-risk than low-risk group, the differences were not significant ($P = 0.432$, 0.940, and 0.331, respectively) (**Table 4**).

All 89 procedures were completed laparoscopically, requiring no open conversion or blood transfusion. Operative complications included postoperative wound infection (two cases), pelvic effusion (four cases), and urine leakage (two cases). No cases of rectal injury or pelvic infection were reported.

In validation Group A, we rated each patient using our scoring system, divided all 88 patients into a low-risk group (38 patients) and high-risk group (50 patients), and validated the meaningful results of our previous study. The average OT and EBL in the low-risk group were 76.0 min and 63.8 ml, respectively, while those in the high-risk group were 93.9 min and 124.9 ml, respectively. The PSM rates in the two groups were 10.5% (4/38) and 32.0% (16/50). Significant differences in OT, EBL, and PSM rates ($P = 0.004$, 0.001, and 0.038, respectively) were present between the two groups. In addition, in validation Group B, we used our scoring system to divide all 59 patients into a low-risk group (34 patients) and high-risk group (25 patients). The average OT and EBL in the low-risk group were 160.3 min and 141.8 ml, respectively, while those in the high-risk group were 186.9 min and 230.0 ml, respectively. The PSM rates in the two groups were 11.8% (4/34) and 40.0% (10/25). Significant differences in OT, EBL, and PSM rates ($P = 0.020$, 0.026, and 0.012, respectively) were present between the two groups (**Table 5**).

Table 1: Summary of overall data

Factors	*Scoring group (n=89)*	*Validation Group A (n=88)*	*Validation Group B (n=59)*	*P*
Age (year), mean±s.d.	67.0±7.5	67.3±6.8	64.4±7.1	0.041
Height (month), mean±s.d.	1.71±0.05	1.70±0.05	1.71±0.06	0.294
Weight (kg), mean±s.d.	71.7±9.2	70.4±9.0	71.8±10.7	0.581
BMI (kg m^{-2}), mean±s.d.	24.51±2.79	24.42±2.80	24.60±2.86	0.928
Diabetes, *n* (%)	10 (11.2)	13 (14.8)	14 (23.7)	0.118
History of abdominal or pelvic surgery, *n* (%)	3 (3.4)	9 (10.2)	5 (8.5)	0.192
PSA levels (ng ml^{-1}), median (IQR)	13.1 (7.99–16.21)	10.84 (6.77–15.18)	13.47 (6.93–20.68)	0.212
Volume of prostate in ultrasound examination (ml), median (IQR)	35.0 (25.00–42.75)	35.0 (24.18–43.87)	31.0 (23.40–45.00)	0.815
Median lobe protrusion, *n* (%)	26 (29.2)	28 (31.8)	14 (23.7)	0.0001
Clinical staging (*n*)				
T1	0	0	7	0.0001
T2a	2	3	5	0.219
T2b	18	15	21	0.024
T2c	38	42	14	0.011
T3a	26	20	6	0.023
T3b	5	8	6	0.536
OT (min), median (IQR)	80.0 (64.0–94.0)	83.0 (66.3–99.8)	169.0 (145.0–197.0)	0.0001
EBL (ml), median (IQR)	50.0 (20.0 –100.0)	50.0 (20.0 –120.0)	100.0 (50.0–400.0)	0.0001
PSM rate (%)	22.5 (20/89)	22.7 (20/88)	23.7 (14/59)	0.983
LOS (day), median (IQR)	4 (4–5)	5 (4–5)	6 (4–7)	0.0001
DD (day), median (IQR)	3 (3–4)	3 (2–4)	4 (3–6)	0.0001
OE (CNY), median (IQR)	57 779.02 (51 225.56–63 033.68)	58 377.22 (51 768.99–61 912.59)	55 917.82 (51 967.30–61 929.02)	0.857

BMI: body mass index; PSA: prostate-specific antigen; OT: operative time; EBL: estimated blood loss; PSM: positive surgical margins; LOS: hospital length of stay; DD: drainage duration; OE: overall expenditure; IQR: interquartile range; s.d.: standard deviation

Table 2: Comparison of factors influencing surgical difficulty in the IUPU score system

Factors	*BMI (kg m^{-2})*			*Prostate volume in B-ultrasound (ml)*			*Preoperative PSA levels (ng ml^{-1})*			*Presence of a median lobe*			*Clinical Stage*		
	<25	*≥25*	*P*	*<30*	*≥30*	*P*	*<10*	*≥10*	*P*	*No*	*Yes*	*P*	*≤cT2b*	*>cT2b*	*P*
Patients (*n*)	54	35		29	60		32	57		63	26		20	69	
OT (min), median (IQR)	76.5 (60.0–90.0)	84.0 (71.0–99.0)	0.035	67.0 (59.0–80.0)	85.0 (72.0–99.0)	0.0001	69.5 (60.8–92.5)	84.0 (69.0–94.0)	0.079	74.0 (61.0–90.0)	89.0 (77.5–104.5)	0.025	70.5 (60.8–83.8)	83.0 (67.0–97.0)	0.157
EBL (ml), median (IQR)	50.0 (20.0–100.0)	50.0 (20.0–102.5)	0.728	30.0 (20.0–70.0)	50.0 (20.0–105.0)	0.018	32.5 (20.0–70.0)	50.0 (20.0–105.0)	0.045	50.0 (20.0–89.0)	92.5 (50.0–116.3)	0.023	20.0 (20.0–30.0)	60.0 (25.0–105.0)	0.001

BMI: body mass index; PSA: prostate-specific antigen; OT: operative time; EBL: estimated blood loss

DISCUSSION

Our clinical experience has shown that many factors are associated with surgical difficulty and risk, including the PSA level, BMI, ultrasonic prostate volume, protrusion of the middle lobe, clinical stage, history of abdominal and pelvic surgery, whether nerve-sparing surgery is performed, whether pelvic or enlarged pelvic lymph node dissection is performed, and other factors. We chose the first five factors as the evaluation indices for the establishment of our scoring system.

The BMI represents the degree of obesity of a patient. In our experience, severe local adhesion and narrow operative spaces are often present in obese patients, making the operation difficult and thus prolonging the operation time. Many other authors have also confirmed these conclusions. Sundi *et al*.[4] and Kaneko *et al*.[5] demonstrated that BMI was an independent predictor of prolonged total OT during LRP. Similar findings were noted in a prospective study involving 100 cases of LRP.[6] In a study by Gözen *et al*.[7] the OT and EBL were higher in the group of overweight patients. Surgeons sometimes consider that the operation is more difficult in some lean patients, mainly because of the patient's smaller pelvic space and smaller operation space. However, in the present study, we found no significant difference in OT or EBL in the scoring group and validation Group A of patients with a BMI of <22, 22–27, and >27 kg m^{-2} (P = 0.668 and 0.405, respectively). Moreover, the clearer operation field and less pelvic fat of lean patients might actually help reduce the difficulty of the operation to some extent. Therefore, we concluded that BMI affects the difficulty of the operation, and lower BMI did not improve the difficulty and risk of operation.

Assessment of the prostate volume is a routine preoperative examination in patients undergoing LRP. The general consensus is that there is no direct pathogenetic relationship between benign prostatic hyperplasia and prostate cancer. In clinical practice, however, the prostate volume can affect the operative difficulty of LRP. Patients with benign prostatic hyperplasia often have a greater blood supply to the prostate, and the time taken to remove a hyperplastic prostate is longer than that required to remove a normal prostate. In the study by Gözen *et al*.[7] a larger prostate size was associated with an extended OT, increased EBL, extended LOS, and increased rate of complications. Frota *et al*.[8] found that the mean EBL was significantly higher in patients with larger prostate glands; however, prostate size exhibited no effect on the OT, LOS, duration of catheterization, continence, or biochemical recurrence 1-year post-LRP. These conclusions are consistent with our usual clinical experience.

The PSA level is correlated with the clinical stage of prostate cancer. In the present study, the proportion of patients with moderate or high risk with a PSA level of >10 ng ml^{-1} was significantly higher than the proportion of patients with a PSA level of <10 ng ml^{-1}, and the clinical stage of most patients was ≥T3. According to our clinical experience, such patients tend to have a high degree of local invasion, severe local adhesion, and abundant tumor vessels, which will increase the intraoperative bleeding volume and operation difficulty.

Middle lobe protrusion is a complex factor affecting the difficulty of LRP because it changes the normal anatomical structure of the bladder neck. This factor will increase the degree of adhesion of the prostate in the bladder neck; thus, preservation of the bladder neck increases the difficulty of the operation, and there may be a need to reconstruct the bladder neck. Studies by Chłosta *et al*.[9] and Patel *et al*.[10] suggested that a large median lobe could alter the anatomy of the bladder neck, causing enlargement and usually necessitating reconstruction during LRP. However, opinions regarding RALP vary. Huang *et al*.[11] and Meeks *et al*.[12] demonstrated a significant

increase in the OT for RALP performed on men with a large median lobe. Several other studies demonstrated that the presence of an enlarged median lobe exerted no effect on the OT, EBL, PSM rate, or urinary continence.[13,14] Hence, the OT was prolonged in patients with herniation of the middle lobe, and the more complicated local operation increased the risk of bleeding.

Clinical stage is one of the most important factors of diagnosis and treatment of prostate cancer. Before getting the pathological stage, urological surgeons always estimate surgical indications or contraindications, according to the clinical stage, develop the treatment if one patient needs neoadjuvant and adjuvant endocrine therapy, and evaluate the prognosis. Generally speaking, patients without distant metastasis whose clinical stage <T4 can be treated with radical surgery. As the progression of tumors, blood supply of tumor and normal gland would increase so that it could increase the risk of damage to the blood vessels and blood loss. Besides, the positive surgical margin rates would increase, too. In our study, the clinical stage was related to EBL significantly, which consisted with clinical experience. In a word, for those patients with locally advanced prostate cancer, the surgical difficulty would enhance significantly.

Before we perform LRP, we usually ask the patient whether he has a history of pelvic or abdominal operations, especially inguinal hernia repair, because hernioplasty will change the normal extraperitoneal anatomic structure and increase the probability of complications. In a series of studies performed 10–15 years ago, many authors pointed out that the difficulty and complications associated with LRP are affected by the history of abdominal pelvic and groin surgery; such complications may include incontinence and increased postoperative pain.[15–17] In recent years, however, other authors indicated that LRP was feasible and safe after inguinal hernia repair.[18,19] In the present study, few patients had a surgical history, so this factor was excluded. We believe that as surgical techniques become increasingly more mature, the difficulty of the operation will gradually decrease and the effect of a surgical history on LRP will be smaller.

Whether pelvic lymph node dissection or even enlarged lymph node dissection should be performed during LRP remains controversial. The current guidelines still recommend the performance of extended lymph node dissection in high-risk patients to clarify the patient's tumor stage and guide further treatment.[20] In the present study, none of the extraperitoneal operations involved lymph node dissection, while all transabdominal surgeries involved pelvic lymph node dissection (but not extended lymph node dissection). The OT and bleeding volume of transperitoneal surgery are higher than those of extraperitoneal surgery. The clearance of lymph nodes requires a more extensive operation, thus prolonging the OT and increasing the risk of intraoperative bleeding. However, whether lymph node dissection is needed remains controversial, and extraperitoneal radical resection of prostate cancer with neoadjuvant endocrine therapy is still a treatment choice for high-risk patients. Hence, no uniform standard has been established regarding what type of surgery should be chosen by surgeons. In addition, our scoring system is used to assess the operation difficulty rather than compare two operative methods. Therefore, we did not include this factor in the scoring standard.

Many authors have argued that nerve sparing is helpful for patients to restore sexual function and urinary continence.[21,22] However, patients require rigorous assessment to determine whether they should undergo nerve-sparing surgery, even if nerve sparing is not associated with worse cancer outcomes.[23] All patients in the present study were treated without nerve-sparing surgery, and this operation was not included in the scoring system. Our scoring system focuses on the initial preoperative evaluation according to the patients' primary information. It is necessary to assess whether the patient is suitable for nerve-sparing surgery, and such an evaluation is complex. In addition, nerve sparing is optional rather than compulsory.

The focus of our scoring system is to allow for a preliminary assessment of the surgical difficulty by collecting the patients' basic information. This is the first time that preoperative assessment has been performed with a scoring system. In many developed countries, regions, and some large hospitals, increasingly more patients are undergoing robotic surgery, while the proportion of those undergoing laparoscopic surgery has been decreasing. However, laparoscopic

Table 3: Score for each preoperative factor used in the Institute of Urology, Peking University score system

Factors	*Score*
BMI (kg m^{-2})	
<25	0
≥25	1
Prostate volume in ultrasound examination (ml)	
<30	0
≥30	2
Preoperative PSA levels (ng ml^{-1})	
<10	0
≥10	1
Presence of a median lobe	
No	0
Yes	2
Clinical stage	
≤cT2b	0
>cT2b	1

BMI: body mass index; PSA: prostate-specific antigen

Table 4: Comparison of postoperative data between low-risk and high-risk groups divided by the Institute of Urology, Peking University score

Factors	*Group*		*P*
	Low-risk	*High-risk*	
PSM rate (%)	12.2	31.3	0.032
LOS (day), median (IQR)	4 (3.5–5.5)	4 (4–5)	0.816
DD (day), median (IQR)	3 (2–4)	3 (3–4)	0.397
OE (CNY), median (IQR)	59 548.50 (52 504.55–64 323.18)	55 852.57 (48 549.41–61 668.20)	0.071
Urinary continence rate (%)			
3 months postsurgery	37.0	47.1	0.432
6 months postsurgery	66.7	67.6	0.940
12 months postsurgery	83.3	93.9	0.331

PSM: positive surgical margins; LOS: hospital length of stay; DD: drainage duration; OE: overall expenditure

Table 5: Comparison of data between low-risk and high-risk groups in validation Group A and B

Factors	*Group*		*P*
	Low-risk	*High-risk*	
Validation group A			
OT (min), median (IQR)	72.0 (59.3–85.5)	87 (74–104.8)	0.004
EBL (ml), median (IQR)	22.5 (20.0–70.0)	105 (42.5–160)	0.001
PSM rate (%)	10.5	32.0	0.038
Validation group B			
OT (min), median (IQR)	155.5 (127.5–185.0)	190.0 (165.0–214.0)	0.020
EBL (ml), median (IQR)	100.0 (50.0–200.0)	200.0 (100.0–300.0)	0.026
PSM rate (%)	11.8	40.0	0.012

OT: operative time; EBL: estimated blood loss; PSM: positive surgical margins

surgery remains dominant in many developing countries, regions, and grassroots hospitals, and our scoring system has a high clinical value for these surgeons. Furthermore, for a surgeon who just started with LRP, or was in the learning curve, this scoring system will help surgeons choose right cases to develop the surgical skill through operations. It also means that most of unnecessary surgical risks will be avoided based on the system. With the accumulation of surgical experience, surgeons can challenge more difficult and complex cases through preoperative evaluation to go through the learning curve safely and rapidly.

Our research has several shortcomings and limitations. First, robotic surgery has gradually become the mainstream technique. However, because of the late development of robotic operations in our hospital and the shortage of cases, our scoring system cannot be used to effectively evaluate the influence of these indicators on the difficulty of robotic operations. Second, for those patients who accepted neoadjuvant endocrine therapy, our system could not provide an accurate assessment result. Third, our evaluation system can only predict the risk of positive margins after surgery; it cannot predict the recovery of postoperative urinary continence. Further studies are needed to evaluate factors that affect the recovery of urinary continence.

The IUPU prostatectomy score is based on five simple and easily obtained factors. Urologists can easily use this system to evaluate the surgical difficulty and predict the risk of PSM and urinary incontinence in patients undergoing LRP.

AUTHOR CONTRIBUTIONS

BLM and LY carried out the studies, participated in the data analysis, and drafted the manuscript. BLM, LY, HFS, ZNZ, and SML carried out the data collection. QZ was the initiator of the project and research, provided the cases and surgical data for this study, and undertook the funding. WY, YW, ZSH, JJ, and LQZ performed the critical revision for important intellectual content and supervised the drafting of the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declared no competing interests.

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