

Building a Nomogram for Prediction of Prostate Cancer in Patients With Preoperatively Suspected Prostate Cancer

YEN CHUAN OU^{1,2}, KUANG-HSI CHANG^{2,3,4}, MIN-CHE TUNG¹, I-JU TSAI⁵, LI-HUA HUANG¹,
WEI-CHUN WENG¹, CHAO-YU HSU¹, YI-SHENG LIN¹ and TANG-YI TSAO⁶

¹Division of Urology, Department of Surgery, Tungs' Taichung Metro Harbor Hospital, Taichung, Taiwan, R.O.C.;

²Department of Research, Tungs' Taichung Metro Harbor Hospital, Taichung, Taiwan, R.O.C.;

³Graduate Institute of Biomedical Sciences, China Medical University, Taichung, Taiwan, R.O.C.;

⁴General Education Center, Jen-Teh Junior College of Medicine,
Nursing and Management, Miaoli, Taiwan, R.O.C.;

⁵Management Office for Health Data, College of Medicine, China Medical University, Taichung, Taiwan, R.O.C.;

⁶Department of Anatomical Pathology, Tungs' Taichung Metro Harbor Hospital, Taichung, Taiwan, R.O.C.

Abstract. *Background/Aim:* Expanded indications for patients with preoperatively suspected prostate cancer (PC) undergoing theranostic robotic-assisted laparoscopic radical prostatectomy (T-RARP) are reported. We aimed to build a nomogram of T-RARP to predict final pathologically proven PC. This study reviewed data of 153 patients that underwent T-RARP for suspected PC performed by the same surgeon. *Patients and Methods:* Patients' preoperative demographic and clinical characteristics included age, prostate-specific antigen (PSA) level, PSA density (PSAD), history of acute urinary retention (AUR), abnormal digital rectal examination (DRE) of the prostate, and Prostate Imaging Reporting and Data System (PI-RADS) classification at 3-T multiparametric magnetic resonance imaging (MRI). Logistic regression with backward elimination was used to select potential risk factors. *Results:* Based on Harrell's guidelines, we chose seven variables for our final model: Age, DRE corresponding with MRI, AUR, PSAD, prostate-specific antigen velocity (PSAV), PI-RADS, and biopsy pathology. A nomogram for prediction of adenocarcinoma was developed. The original C-index for the nomogram was 0.80 (95% confidence interval=0.74-0.89). The cut-off of the nomogram score for predicting PC was 50 (sensitivity=55.4%;

specificity=91.9%). The receiver operating characteristic curve of the model analysis showed an area under the curve of 0.801. *Conclusion:* A nomogram was produced using age, DRE-corresponding MRI, AUR, PSAD, PSAV, PI-RADS, and biopsy pathology. A preoperative nomogram prediction of prostate adenocarcinoma can help the patient and his family understand the possibility of PC and assist them in their decision-making.

The da Vinci robotic surgery system offers a platform for technical improvement and refinements, especially in robotic-assisted radical prostatectomy (RARP) (1). Patients undergoing RARP for prostate cancer (PC) have been shown to have few perioperative complications, rapid functional recovery and lasting long-term oncological control (2, 3). Ten-year actuarial cancer-specific survival rates have reached 98.8% (3). Our robotic team has been mentored by Professor Ashutosh K. Tewari and Professor Vipul R. Patel since 2005. Complication rates decreased significantly to 4% after 600 cases of RARP (4). In a report on 230 patients that underwent RARP with bilateral neurovascular preservation, the continence rate was 98.3% and potency was 86.1% (5). The negative surgical margin rate was 77.0% overall, and in the patient cohort with a low, intermediate, and high risk it was 53.3%, 34.9%, and 11.8% (5). The long-term oncological outcome showed that the 8-year biochemical recurrence-free survival rate among low-risk patients was 95.5% (6). Expanded indications for 55 patients with preoperatively suspicious PC that underwent prophylactic RARP have been reported (7). That study was the first to report that no biopsy-proven PC patients underwent prophylactic RARP with bilateral neurovascular bundle preservation, and that it is safe when performed by experienced surgeons (7). RARP improves urinary function and quality of life postoperatively

Correspondence to: Yen-Chuan Ou, MD, Ph.D., Deputy Superintendent, Professor at the Department of Urology of Tung's Taichung Metro Harbor Hospital, No.699, Sec. 8, Taiwan Blvd. Taichung City 435, Taiwan, R.O.C. Tel: +886 0426581919 #4153, Fax: +886 0426581155, Mobile: +886 926918348, e-mail: ycou228@gmail.com

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Table I. Comparison of preoperative and postoperative pathology in robotic-assisted radical prostatectomy (n=153).

Postoperative diagnosis	Preoperative diagnosis				Total (n=153)	
	ASAP (n=3)	PIN (n=10)		Benign (n=73)		No biopsy (n=67)
		LG	HG			
Adenocarcinoma (n=69)	1	0	6	27	35	69
ASAP (n=12)	1	0	0	9	1	11
PIN (n=36)						
LG	0	0	0	5	3	8
HG	1	0	3	15	9	28
Benign (n=37)	0	1	0	17	19	37

ASAP: Atypical small acinar proliferation; PIN: prostate intraepithelial neoplasia; Benign: nodular hyperplasia (NH) or inflammation; LG; low grade; HG: high grade.

(7). Prophylactic RARP has been redefined as theranostic robot-assisted radical prostatectomy (T-RARP) because the PC can be both diagnosed and treated using this procedure. The numbers of patients with suspected PC using T-RARP are increasing and a nomogram is needed to predict the incidence of PC preoperatively. Using a nomogram, patients can more easily decide whether to undergo RARP or robotic-assisted simple prostatectomy, or follow-up only. This study aimed to report on the development of a nomogram for the prediction of PC in patients who underwent T-RARP for suspected PC, using 153 cases.

Patients and Methods

We retrospectively reviewed data of a single-surgeon experience with 1,500 patients who underwent RARP at Taichung Veterans General Hospital and Tungs' Taichung Metro Harbor Hospital, Taichung, Taiwan, ROC, between Dec. 2005 and Aug. 2017. Preoperatively, 153 patients with suspicious PC were enrolled in this study. Patients were stratified by final pathology reports of T-RARP specimens into three groups: PC; abnormal [atypical small acinar proliferation (ASAP) or prostate intraepithelial neoplasia (PIN)]; and benign (nodular hyperplasia or inflammation).

The Institutional Review Board of our hospital reviewed and approved the study protocol (IRB number: CE 17196B). We performed the first T-RARP in February 2012. All patients understood RARP complications, and the incidence of urinary incontinence and impotence. Moreover, they were aware that the final pathology after RARP might reveal benign lesions.

Clinical parameters, including age, body mass index (BMI), American Society of Anesthesiologists (ASA) anesthetic/surgical risks class, prostate specific antigen (PSA) levels, prostate volume, PSA density (PSAD), PSA velocity (PSAV), history of acute urinary retention (AUR), pathology of biopsy, abnormal digital-rectal exam (DRE) of prostate, suspicious prostate lesion on 3-T multiparametric magnetic resonance imaging (mpMRI), family history of PC and whether patients were medical personnel, were collected preoperatively. MRI interpretation with Prostate Imaging Reporting and Data System (PI-RADS) classification version 2 was adopted

(8). DRE corresponding to MRI as a predictive factor was analyzed with correspondence defined as a prostate nodule of more than 1.5 cm on DRE and MRI showing the prostate lesion with interpretation of a PI-RADS score of 5.

The procedure undertaken for all cases was RARP with neurovascular bundle preservation, as previously described (9, 10). Operative parameters were recorded for each surgery. All specimens were fixed as systematic stepwise sections of the prostate, and were interpreted by a pathologist (10).

All continuous data are expressed as the mean±SD. All statistical calculations were carried out using SPSS 12.0 for Windows (SPSS, Inc., Chicago, IL, USA). Statistical analysis was performed using the Kruskal–Wallis test, Mann–Whitney *U*-test, chi-squared test and multiple logistic regression, as appropriate. A *p*-value of less than 0.05 was considered statistically significant. Multiple logistic regression for predictive parameters of PC before RARP was calculated.

Logistic regression with backward elimination was used to select potential risk factors (11). Based on Harrell's guidelines (12, 13) seven variables were chose for our final model: AGE, DRE corresponding with MRI, AUR, PSAD, PSAV, PI RADS, and biopsy pathology. The 95% confidence interval of Harrell's concordance index (C-index) was obtained from 1,000 bootstrap resampling. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA) and R (R Core Team 2017).

Results

Table I shows a comparison of preoperative and postoperative pathologies in T-RARP. Eighty-six patients underwent transrectal ultrasound (TRUS)-guided prostate needle biopsy 1-4 times. A final postoperative pathology of adenocarcinoma was found in 34 (39.5%) patients, ASAP or PIN in 34 (39.5%) and a benign lesion in 18 (21%). ASAP or PIN was noted in 13 patients preoperatively, and final pathology revealed adenocarcinoma in seven, ASAP or PIN in five, and benign lesions in one. In 67 cases without prostate biopsy, at the patient's request, the final pathology proved to be adenocarcinoma in 35 (52.2%), ASAP or PIN in 13 (19.4%), and benign lesions in 19 (28.4%). The

Table II. Preoperative clinical characteristics, operation parameters and complication rate of robotic-assisted radical prostatectomy for suspicious prostate cancer.

Clinical data		Total	Prostate cancer (n=69)	Abnormal (n=47)	Benign (n=37)	p-Value
Age, years	Mean±SD	66.84±0.54	68.32±0.83	66.55±1.03	64.43±0.84	0.033 ^a
BMI, kg/m ²	Mean±SD	24.93±0.25	24.99±0.38	24.99±0.45	24.73±0.48	0.977 ^a
ASA score, n (%)	I	11 (7.2%)	3 (4.3%)	3 (6.4%)	5 (13.5%)	0.361 ^b
	II	116 (75.8%)	54 (78.3%)	34 (72.3%)	28 (75.7%)	
	III	26 (17.0%)	12 (17.4%)	10 (21.3%)	4 (10.8%)	
Prostate volume, cm ³	Mean±SD	61.63±2.28	56.87±3.68	65.95±3.80	65.00±4.19	0.027 ^a
PSA, ng/ml	Mean±SD	15.35±1.47	17.21±2.65	14.93±2.43	12.39±1.72	0.399 ^a
F/T PSA ratio	Mean±SD	20.12±0.49	19.74±0.85	19.95±0.73	21.06±0.86	0.045 ^a
PSAD, ng/ml ²	Mean±SD	0.30±0.03	0.39±0.06	0.24±0.03	0.20±0.02	0.077 ^a
PSAD, n (%)	>0.15 ng/ml ²	92 (60.1%)	43 (62.3%)	27 (57.4%)	22 (59.5%)	0.867 ^b
PSAV, n (%)	>0.75 ng/ml/year	85 (55.6%)	50 (75.5%)	17 (36.2%)	18 (48.6%)	<0.001 ^b
Symptom score	Mean±SD	19.78±0.68	18.58±1.11	21.02±1.15	20.31±1.24	0.395 ^a
AUR, n (%)	Yes	42 (27.5%)	13 (18.8%)	14 (29.8%)	15 (40.5%)	0.059 ^b
Biopsy duration	Mean±SD	0.83±0.08	0.74±0.11	0.98±0.12	0.81±0.20	0.085 ^a
Biopsy pathology, n (%)	Adenocarcinoma	3 (3.5%)	1 (2.9%)	2 (5.9%)	0 (0%)	0.495 ^b
	ASAP/PIN	10 (11.6%)	6 (17.6%)	3 (8.8%)	1 (5.6%)	
	Benign	73 (84.9%)	27 (79.4%)	29 (85.3%)	17 (94.4%)	
DRE, n (%)	Normal	91 (75.8%)	32 (46.4%)	33 (70.2%)	26 (75.7%)	0.011 ^b
MRI (PI-RADS score), n (%)	2-3	53 (40.8%)	12 (20.7%)	23 (54.8%)	18 (60.0%)	<0.001 ^b
	4-5	77 (59.2%)	46 (79.2%)	19 (45.2%)	12 (40.0%)	
Family history of PC, n (%)		10 (6.5%)	6 (8.7%)	3 (6.4%)	1 (2.7%)	0.492 ^b
Medical personnel [§] , n (%)		12 (7.8%)	8 (11.6%)	3 (6.4%)	1 (2.7%)	0.242 ^b
DRE corresponding to MRI, n (%)	Yes	10 (6.5%)	10 (14.5%)	0 (0%)	0 (0%)	
Console time, min	Mean±SD	119.59±2.34	114.39±3.20	117.57±4.32	113.84±4.81	0.007 ^a
VAT, min	Mean±SD	19.29±0.44	18.22±0.67	19.90±0.69	20.63±0.87	0.008 ^a
Blood loss, ml	Mean±SD	104.51±8.70	77.17±6.96	97.02±12.80	165.0±27.29	0.001 ^a
Complication rate*, n (%)	Yes	6 (3.9%)	4 (5.8%)	1 (2.1%)	1 (2.7%)	0.551 ^b
Specimen volume, cm ³	Mean±SD	64.57±2.32	59.86±3.71	68.47±3.88	68.38±4.32	0.054 ^a

ASA: American Society of Anesthesiologists anesthetic/surgical risks class; AUR: acute urinary retention; BMI: body mass index; DRE: digital rectal examination; F/T PSA: free/total prostate-specific antigen; MRI: magnetic resonance image; PI-RADS: prostate imaging reporting and data system; PSAD: PSA/prostate volume by trans-rectal sonography; PSAV: PSA velocity; VAT: vesicourethral anastomosis time. ^aKruskal–Wallis test; ^bchi-squared test. [§]Patients who were also medical personnel. *Complications: Clavien grade I: ileus in three, bowel injury with repair in one, bladder injury with repair in one during surgery; Clavien grade IV myocardia ischemia in one.

postoperative results were: PC in 69 (45.1%); abnormal (ASAP or PIN) in 47 (30.7%) and benign in 37 (24.2%).

With regard to preoperative clinical characteristics of RARP for suspected PC, patient age in the PC group was significantly older than that in the other two groups ($p=0.033$). Prostate volume was significantly larger in the abnormal and benign groups than in the PC group ($p=0.027$). The incidence of PSAV>0.75 ng/ml/year was significantly higher (75.5%) in the PC group than in the abnormal and benign groups (36.2% and 48.6%) ($p<0.001$). The incidence of abnormal DRE was significantly higher (53.6%) in the PC group than in the other groups (29.8% and 29.7%, respectively) ($p<0.001$). The incidence of PI-RADS score 4–5 by MRI was also higher in the PC group than in the abnormal and benign groups (79.3%, 45.2% and 40%, respectively), and the differences were significant ($p<0.001$). There was a DRE corresponding to MRI in 10 patients only,

and all 10 patients were proven to have prostate adenocarcinoma (Table II).

Operation parameters and complication rates of RARP are shown in Table II. The console time was less than 2 hours and no patients required blood transfusion. The complication rate was 3.9% (6/153), of Clavien–Dindo grade I in five cases: ileus in three, bowel injury with intraoperative repair in one, and bladder injury with intraoperative repair in one case during surgery. On postoperative day 3, a patient suffered from a Clavien–Dindo grade IV complication of myocardia ischemia; he recovered well after medical treatment.

The final pathological characteristics of PC in 69 patients included the following: Tumor volume was ≤ 1 ml in 23 (33%) patients and <0.5 ml in eight (11.6%). The positive surgical margin rate was 23.1% and angiolymphatic invasion was 8.7%. Clinically nonsignificant PC amounted to 10.1% (seven out of 69 patients) (Table III).

Table III. Pathological characteristics of prostate cancer after robotic-assisted radical prostatectomy (n=69).

Factor	Value
Tumor volume, ml	
Mean (range)	5.38 (0.01-28)
≤1 ml	23 (33%)
<0.5 ml	8 (11.6%)*
Tumor %	
Mean (range)	12.17 (0.1-65.00)
Pathology stage, n (%)	
T2a	4 (5.8%)
T2b	20 (29.0%)
T2c	20 (29.0%)
T3a	21 (30.4%)
T3b	4 (5.8%)
PSM, n (%)	16 (23.1%)
pT2	6 (13.6%)
pT3	10 (40.0%)
Gleason score, n (%)	
5	5 (7.2%)
6	28 (40.6%)
7	28 (40.6%)
8	4 (5.8%)
9	4 (5.8%)
Perineural invasion, n (%)	23 (33%)
ALI	6 (8.7%)
Node metastasis	1 (1.4%)

ALI: Angiolymphatic invasion; PSM: positive surgical margin. Tumor volume ≤1 ml in 23 patients: 0.1 ml in n=4, 0.2 ml in n=1, 0.3 ml in n=2, 0.4 ml in n=1, 0.5 ml in n=4, 0.6 ml in n=2, 0.7 ml in n=2, 0.8 ml in n=5, 1 ml in n=2. *One patient with a 0.2 ml tumor and Gleason score: 3+4=7.

There were five preoperative predictive parameters that had a mean odds ratio for PC group *versus* the benign group ranging from 2.73 to 11.21, and a *p*-value from <0.001 to 0.043. These five factors were PSAD, PSAV, AUR, DRE and MRI PI-RADS score (Table IV).

Figure 1 presents the nomogram for the prediction of PC in patients undergoing T-RARP for suspected PC. We provided three examples for calculation of the nomogram score in Table V. The original C-index for the nomogram was 0.80 with 95% confidence interval=0.74-0.89. The average C-index of the 1,000 bootstrap resamples was 0.81. We set a cut-off nomogram score of 50 after calculating the score to be 50.019 at the largest Youden value of 0.4725. The sensitivity was 55.4% and specificity was 91.9%. The receiver operating characteristic curve of the model analysis showed the area under the curve was 0.801 (Figure 2).

Discussion

This study is the first to report a nomogram for the prediction of PC from among 153 patients undergoing T-

RARP for suspected PC. The procedures were performed by a single experienced surgeon without surgical bias. A nomogram to predict adenocarcinoma was developed using seven parameters. The cut-off of the nomogram score for predicting PC was 50, with sensitivity of 55.4% and specificity of 91.9%.

This procedure was previously known as prophylactic RARP (7). Now, we have defined it as theranostic RARP, a diagnostic and therapeutic procedure for patients with suspected PC. In this current series, we found that 45.1% of suspected cases actually had PC. We needed to build a nomogram for prediction of patients with PC among those undergoing T-RARP for suspected PC. High specificity is necessary so that RARP is not used in cases with a low probability of PC. For patients with a nomogram score of more than 50, RARP is suggested. Observation/close follow-up or simple prostatectomy is suggested for patients with a nomogram score of less than 50.

In 2004, Brausi *et al.* reported radical prostatectomy in 25 patients with ASAP (14). All patients were proven to have adenocarcinoma, they therefore concluded that immediate radical prostatectomy is not overtreatment (14). Similarly, radical prostatectomy is sometimes considered in patients with high-grade PIN (15). Transperineal template saturation biopsy was performed every 5-mm in another study. The PC detection rates were 53% (9/17), 89% (8/9), and 83% (10/12) in patients with high-grade PIN and in those who had two or more cores of high-grade PIN or ASAP, respectively (16). In our series, 13 cases of ASAP or PIN were found in the TRUS biopsy preoperatively, and the final pathology at RARP revealed adenocarcinoma in 61.5%, ASAP/PIN in 30.8% and benign disease in 7.7%. Using our nomogram with these 13 cases, a nomogram score >50 was noted in seven of eight patients with PC. One patient with a nomogram score of 30.25 had pT2a PC, with Gleason score 6, and 1% of tumor (volume 1 ml). One of five non-PC patients had a nomogram score of 52.7, and the final pathology was high-grade PIN. Among these 13 cases of ASAP or PIN in the TRUS biopsy, using a nomogram score cutoff of 50, sensitivity was 87.5% and specificity was 80%.

Two important clinical trials for PC screening, the Prostate Cancer Prevention Trial (PCPT) and the European Randomized Study of Screening for Prostate Cancer (ERSPC) (17), use nomograms and risk calculators. Their online risk calculators are used to indicate individual risk of biopsy positivity, and are available (18, 19). Determining the risk of a positive biopsy using the PCPT calculator relies on family history, PSA, DRE, and prior biopsy (20). The ERSPC risk calculator includes age, family history, PSA, DRE, prostate volume and previous negative biopsy, and can estimate individual 4-year PC risk. Their standard diagnosis for PC relies on the TRUS prostate biopsy pathology. Sometimes, the TRUS prostate biopsy may miss a small

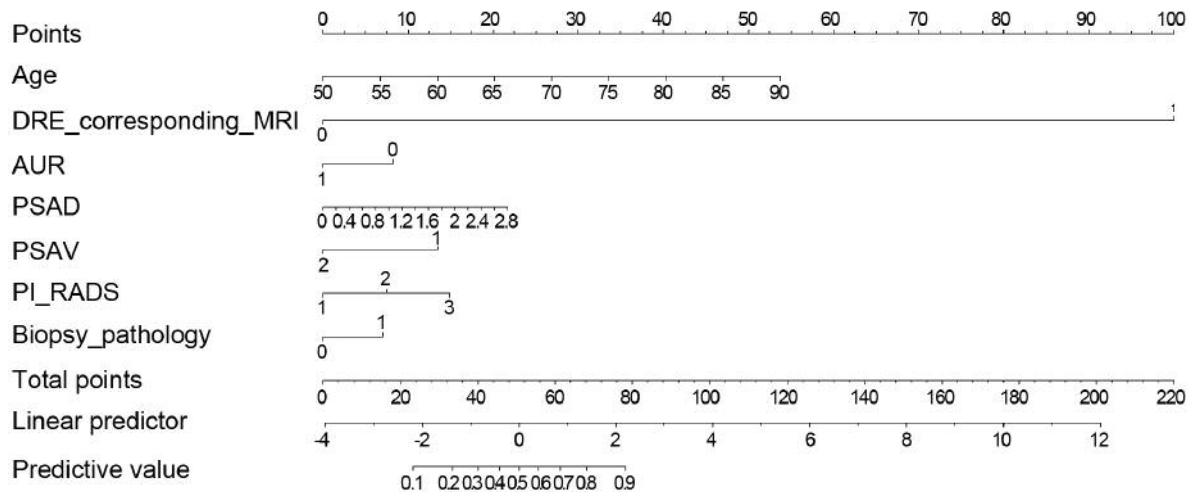


Figure 1. Nomogram predicting prostate cancer among men undergoing theranostic robotic-assisted laparoscopic radical prostatectomy for suspicion of prostate cancer. ASAP: Atypical small acinar proliferation; AUR: acute urinary retention; DRE: digital rectal examination; BMI: body mass index; MRI: magnetic resonance image; PIN: prostate intraepithelial neoplasia; PI-RADS: Prostate Imaging Reporting and Data System; PSA: prostate-specific antigen; PSAD: PSA/prostate volume by trans-rectal sonography; PSAV: PSA velocity.

Table IV. Parameters predictive of prostate cancer before robotic-assisted radical prostatectomy: Odds ratio for prostate cancer versus benign disease.

Preoperative parameter	Mutually adjusted OR	95% CI	p-Value
Age	1.11	1.03-1.20	0.005
BMI	1.03	0.90-1.18	0.672
PSA	1.02	0.99-1.06	0.244
F/T PSA ratio	0.97	0.91-1.03	0.321
Prostate volume	0.99	0.98-1.00	0.175
PSAD	11.21	1.08-116.4	0.043
PSAD >0.15 vs. <0.15 ng/ml ²	1.13	0.50-2.55	0.773
PSAV >0.75 vs. <0.75 ng/ml/year	2.78	1.21-6.39	0.016
Symptom score	0.97	0.93-1.03	0.318
AUR No vs. yes	2.86	1.18-7.14	0.020
Biopsy ASAP or PIN/benign	4.41	0.50-39.04	0.183
Biopsy vs. no biopsy	1.03	0.46-2.28	0.951
No. biopsies >1 vs. 0 or 1	1.35	0.44-4.17	0.605
Digital examination Abnormal vs. normal	2.73	1.17-6.39	0.020
MRI PI-RADS score 4-5 vs. 2-3	5.75	2.18-15.14	<0.001
Family history of PC	3.43	0.40-29.32	0.263
Medical personnel [§]	4.72	0.57-39.31	0.151

ASAP: Atypical small acinar proliferation; AUR: acute urinary retention; F/T PSA: free/total prostate-specific antigen; BMI: body mass index; MRI: magnetic resonance image; PIN: prostate intraepithelial neoplasia; PI-RADS: prostate imaging reporting and data system; PSAD: PSA/prostate volume by trans-rectal sonography; PSAV: PSA velocity. [§]Patients who were also medical personnel. Bold values show significance.

tumor or prostate tumor in the anterior lobe. For our cohort, we used the final pathology of the T-RARP specimen, since it is more reliable and there is no verification bias.

Our predictor incorporated PI-RADS scores 4 and 5 on MRI, which would contribute to the risk of PC. A previous study reported that the tumor incidence in a systematic 12-core biopsy adding cognitive fusion-targeted biopsy on

mpMRI was 88% and 94% in those with PI-RADS V2.0 scores 4 and 5, respectively (21). In our hospital, we do not perform mpMRI targeted biopsy (22). Furthermore, DRE corresponding to MRI is a definitive predictor of PC. The definition of DRE corresponding to MRI is a firm prostate nodule more than 1.5 cm in size on DRE and MRI showing the prostate lesion with interpretation with a PI-RADS V2.0

Table V. Three cases as examples for calculation of the nomogram score.

Case	Age, years	DRE corresponding to MRI	AUR	PSAD ng/ml ²	PSAV, ng/ml/year	PIRADS score	Biopsy pathology	Final pathology	Linear predictor	Predictive value
1 Value	66	Yes	No	2.37	>0.75	5	Benign	PC		
Score	21	100	9	19	14	16	0	179 (total)	10.3	>90%
2 Value	62	No	No	0.517	>0.75	4	PIN	PC		
Score	16	0	9	5	14	8	8	58 (total)	0.8	65%
3 Value	66	No	Yes	0.07	>0.75	3	Benign	NH		
Score	21	0	0	1	14	1	0	38 (total)	-1	27%

AUR: Acute urinary retention; Benign: nodular hyperplasia or inflammation; MRI: magnetic resonance image; PC: prostate cancer; PIN: prostate intraepithelial neoplasia; PI-RADS: prostate imaging reporting and data system; PSAD: prostate-specific antigen density; PSAV: prostate-specific antigen velocity.

score of 5. In our cohort, all of the 10 cases of DRE corresponding to MRI had PC. The kernel of the DRE was a more than 1.5-cm firm nodule, which was compatible with focally pronounced hypointensity on apparent diffusion coefficient MRI and pronounced hyperintensity on high b-value diffusion weighted imaging MRI, and was ≥ 1.5 cm in its largest dimension on axial images, which was a PI-RADS V2.0 scores of 5. In 2015, a study reported two cases of radical prostatectomy without prostate biopsy in PI-RADS score 5 lesions on 3T mpMRI, and DRE revealed a prostate nodule (23). They concluded that with a high pre-test probability of PC (rising and elevated PSA, malignant nodule on DRE and a corresponding PIRADS score 5 lesion on mpMRI-P), it may be appropriate to proceed to radical prostatectomy without a prostate biopsy (23). The majority of patients with renal tumor underwent radical nephrectomy or partial nephrectomy as a theranostic procedure without preoperative renal biopsy (24). In the robotic era and with experienced surgeons, preoperative prostate biopsy for patients with highly suspicious PC is a debatable issue.

Our clinical study has two unique advantages. Firstly, it reflects real-world practice with patients with highly suspicious PC and a negative prostate biopsy. The use of T-RARP should be reconsidered for patients with DRE corresponding to MRI and biopsy with ASAP/high-grade PIN. If patients have a family history of PC, suffer from lower urinary tract symptoms and experience sepsis after TRUS biopsy, they are likely to be concerned about sepsis and very anxious about suspected PC. Our nomogram is a good tool to help them make an appropriate decision.

Bilateral prophylactic mastectomy is a model of breast cancer risk reduction, especially for breast cancer gene mutation carriers (25, 26). Bilateral prophylactic mastectomy is a major operation with minor risks, and 84% of patients are satisfied with their decision to go ahead with the procedure (27). We agree with the advice from Coelho *et al.* that the surgeon must provide comprehensive education and counseling to ensure that theranostic surgery is performed

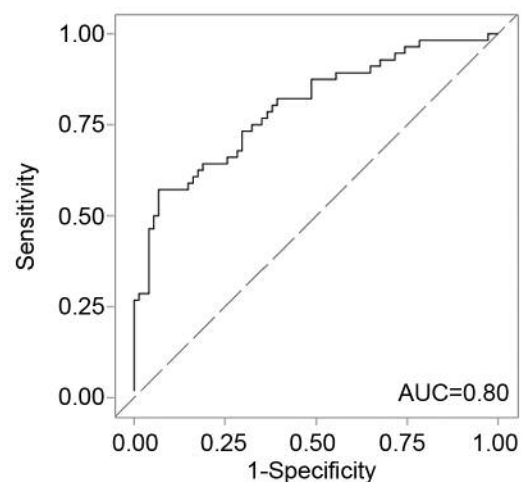


Figure 2. Receiver operating characteristics curve for predicting prostate cancer. The cut-off nomogram score for predicting prostate cancer was 50. Sensitivity was 55.4% and specificity was 91.9%.

under suitable conditions and within the patient's expectations (27). However, the risk of developing PC with gene mutation has not yet been defined. Therefore, our patients were asked to consider their decision after patient group education and discussion across the board.

RARP performed by a very experienced surgeon and in a high-volume institute can minimize the complication rate to about 3% (4, 28, 29); this is extremely close to a gold standard (1). We suggest that T-RARP performed by experienced surgeons is a reasonable option for patients with suspicion of PC.

RARP for patients with suspected PC is not a new robotic procedure but it is a broadened indication. T-RARP includes its own medico-legal issues, and a second opinion is needed for patients and their family. This is clinical practice among high-volume surgeons and in a few countries. The existence of medico-legal issues is ubiquitous. Even with transurethral

resection of the prostate, the mortality rate is 2.5% in Taiwan (30). Perioperative complications and mortality were 6.5% and 0.4% respectively after transurethral resection of the prostate in 4794 cases in the American College of Surgeons National Surgical-Quality Improvement Program database (28). T-RARP can only explain to the patient the probability of PC, not ensure that there is PC. The previous level of sexual function cannot be guaranteed after T-RARP.

T-RARP with bilateral neurovascular bundle preservation is a viable option for suspicion of PC when performed by an experienced surgeon; it is a diagnostic and therapeutic procedure. A nomogram for prediction of PC in patients preoperatively provides the patient and his family the information needed to make a better decision.

Conflicts of Interest

All Authors state that they have no conflicts of interest.

Authors' Contributions

YC Ou, MC Tung: Protocol/project development; YC Ou, MC Tung, LH Huang, WC Weng, CY Hsu, YS Lin, TY Tsao: Data collection or management; YC Ou, MC Tung, KH Chang, IJ Tsai: Data analysis; YC Ou, MC Tung: Article writing/editing.

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