

Original Article



Latency of Bulbocavernosus Reflex Predicts Short-Term Urinary Incontinence Severity after Robot-Assisted Radical Prostatectomy

Danhong Guo^{1, †}, Jing Le^{2, †}, Hong Jiang³, Sisi Mo², Guoqing Ding⁴, Yanlan Yu^{4,*}

¹Nursing Department, Sir Run Run Shaw Hospital, school of medicine, Zhejiang University, Hangzhou, 310016, China;

²Zhejiang University, Hangzhou, 310058, China;

³Department of Neurology, Sir Run Run Shaw Hospital, school of medicine, Zhejiang University, Hangzhou, 310016, China;

⁴Department of Urology, Sir Run Run Shaw Hospital, school of medicine, Zhejiang University, Hangzhou, 310016, China

[†]These authors contributed equally to this work.

*Corresponding Author: Yanlan Yu

Abstract:

Prostate cancer remains a leading cause of morbidity in men, with radical prostatectomy often resulting in postoperative urinary incontinence (UI). This study aimed to identify predictors of UI severity following robot-assisted radical prostatectomy (RARP) using pelvic floor electromyography (EMG) and clinical parameters. A retrospective analysis was conducted on 68 prostate cancer patients who underwent RARP by a single surgeon. Preoperative pelvic floor EMG and the International Consultation on Incontinence Questionnaire–Short Form (ICI-Q-SF) were administered, with postoperative ICI-Q-SF scores assessed at one month. Patients were stratified into low-severity (ICI-Q-SF <8, n=25) and high-severity (ICI-Q-SF ≥8, n=43) UI groups. Age, neurovascular bundle sparing, and bulbocavernosus reflex (BCR) latency differed significantly between groups. Multivariate analysis revealed age and BCR latency as independent predictors of UI severity (areas under the curves (AUC)=0.755, sensitivity=0.721, specificity=0.720). These findings suggest that preoperative BCR latency and age may serve as biomarkers for postoperative UI severity, facilitating personalized risk assessment.

Keywords: Urinary incontinence; Prostate cancer; Robotic surgery; Prostatectomy; Electromyography; Bulbocavernosus reflex

1. Introduction

Prostate cancer (PCa) ranks as a leading malignancy impacting men aged 45–60 and constitutes a significant contributor to global male mortality[1]. Recent epidemiological data reveal marked geographic disparities in both incidence and mortality rates[2]. Global health statistics documented approximately 1.4 million newly diagnosed PCa cases and 375,000 associated deaths in 2020. While China maintains a comparatively low age-standardized incidence rate (4.4 per 100,000), its vast population

translates to substantial absolute disease burden[3]. National cancer surveillance programs now identify PCa as the sixth most prevalent malignancy among Chinese males, positioning it as an emerging public health challenge[4].

Radical prostatectomy—the complete surgical excision of the prostate gland via open or laparoscopic approaches—has remained the gold standard surgical intervention for localized PCa since its introduction in the early 20th century[5]. Current clinical guidelines recommend this

procedure primarily for patients experiencing localized recurrence following prior radiation therapies (external beam radiotherapy, brachytherapy) or cryotherapy, provided no metastatic disease is present. For decades, open radical prostatectomy (ORP) has served as the cornerstone surgical approach for managing localized PCa. However, this surgical approach is associated with postoperative morbidity[6]. Subsequently, laparoscopic radical prostatectomy (LRP) has evolved as a minimally invasive alternative to ORP, aiming to reduce surgical trauma and enhance postoperative recovery[7]. Compared to ORP, LRP demonstrates clear benefits, including decreased intraoperative blood loss, shorter hospitalization, and improved functional preservation. Nevertheless, LRP presents intrinsic limitations, such as the absence of tactile feedback, restricted two-dimensional visualization, and amplified instrument tremors[8]. These technical challenges require advanced surgical expertise, leading to a prolonged learning curve for surgeons[9].

While ORP and LRP have traditionally served as the primary surgical approaches for prostate cancer, recent advancements in operative techniques have optimized both oncological efficacy and functional preservation. Notably, robotic-assisted radical prostatectomy (RARP) has gained significant traction in clinical practice, demonstrating a marked increase in adoption. The pioneering RARP was conducted in 2000 by Binder *et al.*, who, despite lacking prior laparoscopic training, successfully performed the procedure in Frankfurt as an open surgeon transitioning to robotic techniques[10]. Compared to conventional laparoscopic techniques, robot-assisted surgery provides distinct technical benefits, such as enhanced three-dimensional visualization through a high-definition optical system. Additionally, the articulating robotic instruments enable superior surgical precision during tissue dissection, which may contribute to improved functional preservation, lower rates of positive surgical margins (PSM), and optimized perioperative results[11]. Until now, RARP remains the standard surgical intervention for localized prostate cancer, accounting for the highest procedural volume among treatment options for this patient population[12]. Despite advancements in surgical precision and technique, postoperative functional recovery remains limited

in many cases. The most frequent complications include urinary incontinence (UI) and erectile dysfunction (ED)[13]. The incidence of these complications varies across studies due to differences in definitions, patient selection, and surgical techniques[14]. A 2018 study reported postoperative UI and ED rates of 15% and 78%, respectively, at 6 months following RARP[11]. Postoperative UI remains one of the most distressing complications, significantly impairing patients' quality of life and treatment satisfaction.

Postoperative UI following prostatectomy has a multifactorial etiology influenced by several key determinants: advanced patient age, prior transurethral prostate procedures, pre-existing lower urinary tract dysfunction, elevated body mass index, oncologic parameters (clinical stage, PSA level, and Gleason score), prostate gland volume, and the degree of intraoperative neurovascular bundle preservation[15]. Additionally, presurgical pelvic floor anatomy may contribute to post-prostatectomy UI development. The exact pathophysiological mechanisms of post-prostatectomy UI remain incompletely understood[16]. Surgical injury to the urinary sphincter and accompanying pelvic anatomical alterations constitute the primary causes of post-prostatectomy incontinence. While multiple conservative therapies exist for managing post-prostatectomy urinary incontinence—including electrical stimulation, bladder training, and pelvic floor muscle training (PFMT)—evidence suggests PFMT may be particularly effective[17,18]. PFMT is a common conservative therapy, strengthens these muscles through repeated contractions and relaxations, thereby improving muscular tone and urethral resistance to effectively manage urinary leakage[19].

Electromyography (EMG) a low-risk, non-invasive diagnostic method that uses surface electrodes to evaluate muscle function and detect neuromuscular abnormalities. As part of electrodiagnostic medicine, it provides valuable insights for clinical assessment[20]. In addition to diagnosing muscle diseases, EMG biofeedback serves to visualize pelvic floor muscle (PFM) neuromuscular activity. This real-time feedback provides information on muscle performance, with recorded activity displayed on a monitor to facilitate proper exercise technique and reinforce movement patterns. Such feedback—along with

confidence in performing PFM exercises correctly—plays a crucial role in rehabilitating pelvic floor dysfunction (PFD)[21,22]. EMG signals can be acquired through needle electrodes and surface electrodes. surface EMG remains widely used due to its non-invasive and convenient nature. Despite these advantages, it has limitations, including indirect measurement and signal interference from adjacent tissues[23]. Needle EMG involves inserting a needle electrode into a muscle to record and amplify electrical signals from resting or contracting muscle fibers. These signals are then interpreted to assess muscle fiber and motor unit function, providing valuable diagnostic information about neuromuscular activity[24].

While numerous prediction models have been established for post-RARP UI, their predictive performance remains inconsistent[25,26]. Building upon the recognized association between post-prostatectomy UI and pelvic floor neuromuscular function, this prospective study evaluated the relationship between comprehensive preoperative pelvic EMG assessments and post-RARP continence recovery patterns. Specifically, we aimed to develop and validate pelvic EMG parameters as reliable predictors of short-term UI severity, with particular emphasis on quantitative electrophysiological biomarkers that could enhance existing predictive models.

2. Materials and Methods

2.1 Study Population

This retrospective single-center cohort study analyzed 81 consecutive patients undergoing RARP performed by a high-volume surgeon (>200 RARP cases) between December 2022 and September 2023, with 68 patients meeting all

inclusion/exclusion criteria and included in final analysis. Inclusion criteria required: (1) histologically confirmed localized prostate cancer (\leq T2c clinical stage); (2) complete RARP performed by designated surgeon; and (3) available pre-/postoperative data. Exclusion criteria comprised: (1) refusal to participate/incomplete follow-up; (2) prior pelvic trauma/surgery; (3) other malignancies; (4) postoperative rehabilitation participation; (5) pre-existing urinary dysfunction; (6) neurological conditions affecting pelvic function.

2.2 Patient Follow-up and Outcomes

All patients underwent standardized preoperative assessments including needle pelvic EMG examinations, International Consultation on Incontinence Questionnaire Short Form (ICI-Q-SF), and International Prostate Symptom Score (IPSS) questionnaires. These baseline evaluations were conducted 1 day before surgery during the standard preoperative admission process (1-2 days prior to surgery), with the EMG testing performed by certified technicians following electronic orders through the hospital's prescription system. For outcome assessment, the ICI-Q-SF was readministered at the 1-month postoperative follow-up visit. Based on median baseline ICI-Q-SF scores, patients were stratified into lower- and higher-severity incontinence groups for subsequent analysis. A designated research nurse coordinated all questionnaire administration for consistency. The primary study outcome evaluated changes in continence status through regression analysis of these groups following RARP, while secondary outcomes focused on predictive model development and area under the curve (AUC) performance metrics, with the complete study protocol illustrated in Figure 1.

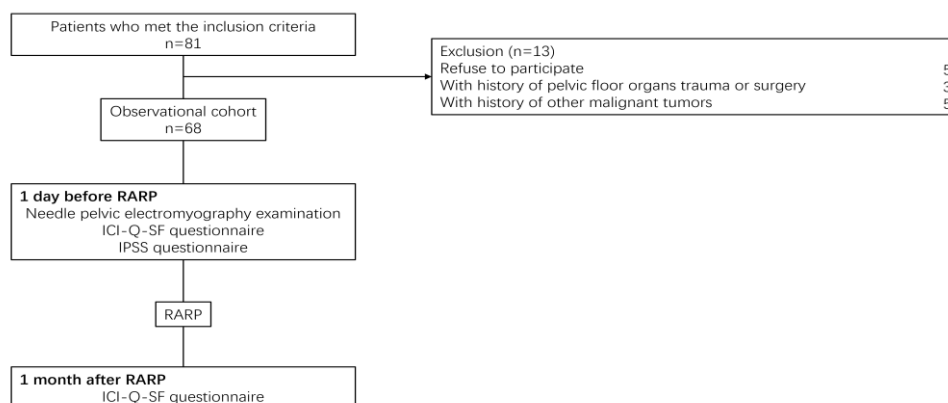


Figure 1. Schematic illustration of the study protocol.

2.3 Surgical Procedure

All patients underwent RARP using the da Vinci® surgical system (Intuitive Surgical, Sunnyvale, CA, USA) via a transperitoneal anterior approach with a standard five-port configuration[27]. The procedure began with an incision at the lower peritoneal fold, followed by bladder neck isolation and subsequent dissection. Next, the seminal vesicles and vas deferens ampulla were mobilized before en bloc removal of the prostate and seminal vesicles. Whenever anatomically feasible, bladder neck preservation was performed, along with unilateral or bilateral neurovascular bundle preservation using an antegrade technique.

2.4 Needle Pelvic EMG Examination Procedure

The pelvic floor EMG assessment was conducted using a Dantec Keypoint® system (Natus Medical Inc., Copenhagen, Denmark). All examinations were performed by a single, experienced technician following standardized protocols established in prior research[20]. Briefly, Patients were positioned in the left lateral decubitus (Sim's position) with the perineum exposed. The perineum and thighs were sterilized using alcohol

swabs, with the right thigh serving as the electrical ground. Utilizing anatomical landmarks, the technician transcutaneously inserted the needle electrode into the target musculature while monitoring insertion activity. Electrode placement was confirmed by having patients perform Kegel maneuvers[28]. Key EMG parameters evaluated included: amplitude and duration of puborectalis and urethral sphincter (US) activity; bulbocavernosus reflex (BCR) latency (Figure 2).

2.5 Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics (version 27.0; SPSS Inc.). Categorical variables are presented as frequencies (percentages), while continuous variables are expressed as medians with interquartile ranges (IQRs). Group comparisons were conducted using either chi-square tests (categorical variables) or Kruskal-Wallis tests (continuous variables), as appropriate. To evaluate predictors of postoperative urinary continence severity, we employed multivariable logistic regression analysis. A two-tailed p-value <0.05 was considered statistically significant.

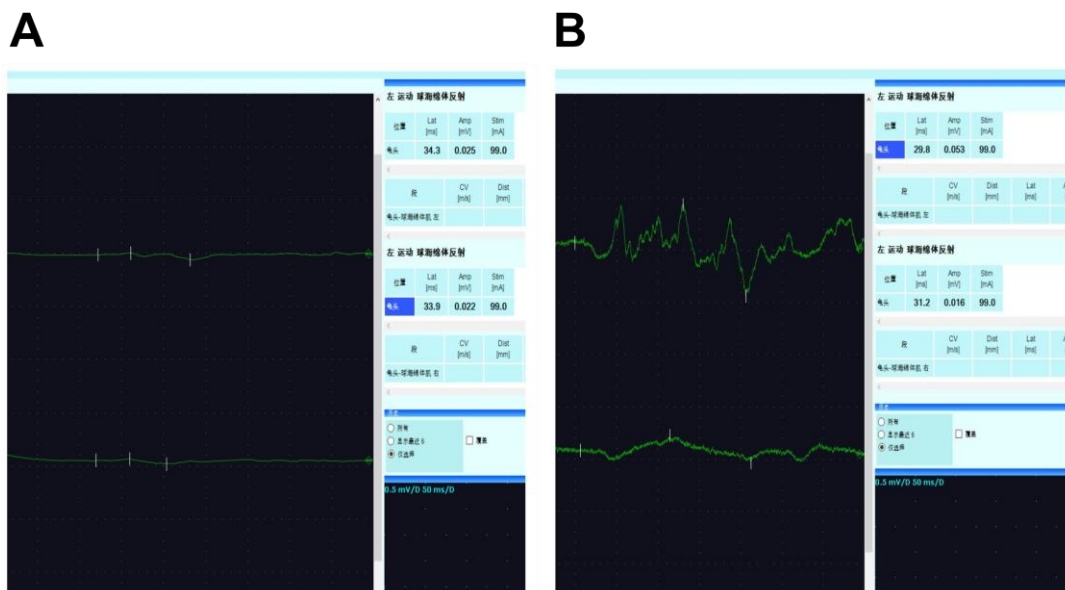


Figure 2. Screenshots of one patient's BCR figures and graphs detected on the EMG device before (A) and after (B) the surgery.

3. Results

The study initially screened 113 consecutive patients who met the inclusion criteria for RARP. During preliminary evaluation, five patients (4.4%) declined further participation, while eight

(7.1%) were excluded due to confounding medical histories that could potentially bias study outcomes. Following surgical intervention, a notable attrition rate was observed, with 32 patients (28.3% of initial cohort) lost to follow-up. This attrition principally consisted of two distinct

subgroups: seventeen patients (15.0%) failed to attend their scheduled 1-month postoperative assessment, while an additional fifteen patients (13.3%) explicitly declined the invasive pelvic needle EMG examination, primarily citing concerns about procedural discomfort. Ultimately, 68 patients completed the full study protocol, representing a final retention rate of 60.2% from the original cohort. This completion rate compares favorably with similar urological studies observing early postoperative functional outcomes.

All enrolled patients were comprehensively evaluated using the TNM staging system, with unanimous clinical staging as either cT2 or cT3 tumors. This uniform staging profile rendered pelvic lymph node dissection unnecessary for all participants, as per contemporary oncological guidelines[29]. The cohort demonstrated broad age representation with a median of 69 years (interquartile range: 62-75 years; full range: 39-84 years), mirroring the typical demographic profile of prostate cancer patients undergoing radical prostatectomy. Postoperative functional assessment using the validated ICI-Q-SF revealed a graded severity distribution: 25 patients (36.8%) exhibited mild incontinence, 40 patients (58.8%) demonstrated moderate incontinence, and only 3 patients (4.4%) presented with severe urinary symptoms. This distribution pattern suggests that while most patients experience some degree of urinary dysfunction in the immediate

postoperative period, severe cases remain relatively uncommon at the 1-month evaluation point.

Our analytical approach involved dichotomizing patients into clinically relevant subgroups based on ICI-Q-SF thresholds: low-severity incontinence (LSI; score <8, n=25) and high-severity incontinence (HSI; score ≥8, n=43). As detailed in Table 1, comprehensive comparison of preoperative clinical parameters and surgical factors between these groups yielded two statistically significant discriminators ($p \leq 0.05$, two-tailed t-test). First, the HSI group demonstrated significantly advanced chronological age (mean 71.2 ± 6.8 years vs. 65.4 ± 7.2 years in LSI), corroborating existing literature on age-related recovery patterns. Second, the utilization of nerve-sparing techniques (neurovascular bundle (NVB)-sparing) showed a strong protective association, with preservation rates of 84% in LSI versus 58% in HSI patients. Subsequent electrophysiological assessments (Table 2) identified a single significant EMG parameter - the BCR latency, which was markedly prolonged in HSI patients. Specifically, 58.14% of HSI patients exhibited BCR latency exceeding 27.5ms compared to only 28% in the LSI group ($p=0.023$, χ^2 test). This electrophysiological disparity suggests potential underlying neurological mechanisms contributing to early continence recovery.

Table 1. Baseline characteristics of the patients

Variable	Total (n = 68)	LSI group (n=25)	HSI group (n=43)	p
Age (year)	69.00 (62.75, 76.00)	63.00 (58.00, 69.00)	73.00 (67.50, 76.50)	<0.001
1 (≤ 69)	36 (52.94)	20 (80.00)	16 (37.21)	<0.001
2 (> 69)	32 (47.06)	5 (20.00)	27 (62.79)	
BMI (kg/m ²)	23.40 (22.15, 25.05)	24.10 (22.30, 25.20)	23.20 (21.90, 24.95)	0.533
1 (≤ 23.4)	34 (50.00)	11 (44.00)	23 (53.49)	0.615
2 (> 23.4)	34 (50.00)	14 (56.00)	20 (46.51)	
Prostate volume (ml)	59.76 (40.71, 80.56)	51.35 (38.76, 81.68)	62.56 (45.39, 78.50)	0.434
1 (≤ 62.5)	33 (50.77)	13 (54.17)	20 (48.78)	0.798
2 (> 62.5)	32 (49.23)	11 (45.83)	21 (51.22)	
Prostate-specific antigen (ng/ml)	9.85 (5.14, 18.79)	11.13 (5.59, 16.44)	8.65 (4.96, 19.82)	0.670
1 (≤ 9.85)	34 (50.00)	11 (44.00)	23 (53.49)	0.615

2 (>9.85)	34 (50.00)	14 (56.00)	20 (46.51)	
Preoperative IPSS	3.00 (1.00, 9.00)	2.00 (1.00, 5.00)	5.00 (1.00, 10.00)	0.327
1 (≤ 3)	36 (53.73)	16 (64.00)	20 (47.62)	0.216
2 (>3)	31 (46.27)	9 (36.00)	22 (52.38)	
Operation time (min)	85.00 (73.75, 100.00)	90.00 (75.00, 100.00)	85.00 (72.50, 94.50)	0.539
1 (≤ 85)	37 (54.41)	11 (44.00)	26 (60.47)	0.215
2 (>85)	31 (45.59)	14 (56.00)	17 (39.53)	
pT stage (%)				0.241
2	40 (58.82)	17 (68.00)	23 (53.49)	
3	28 (41.18)	8 (32.00)	20 (46.51)	
Gleason score (%)				0.110
≤ 6	15 (22.1)	6 (8.8)	9 (13.2)	
7	39 (57.4)	15 (22.1)	24 (35.3)	
≥ 8	13 (19.1)	4 (5.9)	9 (13.2)	
Incision margin				0.725
Negative	50 (73.53)	19 (76.00)	31 (72.09)	
Positive	18 (26.47)	6 (24.00)	12 (27.91)	
BN-sparing				0.695
No	21 (30.88)	7 (28.00)	14 (32.56)	
Yes	47 (69.12)	18 (72.00)	29 (67.44)	
NVB-sparing				0.007
No	39 (57.35)	9 (36.00)	30 (69.77)	
Yes	29 (42.65)	16 (64.00)	13 (30.23)	

Table 2. EMG parameters of the patients

TPUS parameters	LSI group	HSI group	<i>p</i>
MUP amplitude of US			0.603
1 (≤ 500)	10 (45.45)	22 (53.66)	
2 (>500)	12 (54.55)	19 (46.34)	
MUP duration of US			0.115
1 (≤ 11.4)	16 (72.73)	21 (51.22)	
2 (>11.4)	6 (27.27)	20 (48.78)	
MUP duration of Puborectalis			1
1 (≤ 11.5)	11 (52.38)	20 (52.63)	
2 (>11.5)	10 (47.62)	18 (47.37)	
MUP amplitude of Puborectalis			0.422
1 (≤ 559)	9 (42.86)	21 (55.26)	
2 (>559)	12 (57.14)	17 (44.74)	
Latency of BCR			0.023
1 (≤ 27.5)	18 (72.00)	18 (41.86)	
2 (>27.5)	7 (28.00)	25 (58.14)	

Our hierarchical analytical strategy commenced with univariate screening of all potential clinical, surgical, and neurophysiological variables ($p < 0.20$ threshold for inclusion). This preliminary analysis identified four candidate predictors, which were subsequently evaluated in multivariate logistic

regression modeling. The final parsimonious model retained only two independent predictors, both demonstrating robust statistical significance: chronological age (adjusted OR=7.77, 95% CI: 2.12-28.43, $p=0.002$) and BCR latency (adjusted OR=4.81, 95% CI: 1.33-17.42, $p=0.017$), as

documented in Table 3. The model's discriminatory performance, evaluated through receiver operating characteristic analysis, yielded an AUC of 0.755 (95% CI: 0.637-0.873), indicating good predictive accuracy for a clinical model. Operating characteristics (Figure 3) at the optimal cutoff demonstrated balanced sensitivity (72.1%) and specificity (72.0%), suggesting practical clinical utility. These metrics compare

favorably with existing prediction tools for postoperative functional outcomes, while the incorporation of electrophysiological parameters represents a novel methodological advancement in continence prognosis. The strong predictive value of these parameters underscores their potential role in preoperative counseling and individualized postoperative rehabilitation planning.

Table 3. Univariate and multivariate analyses of ICI-Q-SF score groups following RARP.

Variables	Multivariate analysis		
	Z	p	OR
Age (year)			
1 (≤ 69)			1.00 (Reference)
2 (> 69)	3.03	0.002	7.77 (2.06 - 29.33)
Latency of BCR			
1 (≤ 27.5)			1.00 (Reference)
2 (> 27.5)	2.38	0.017	4.81 (1.32 - 17.50)

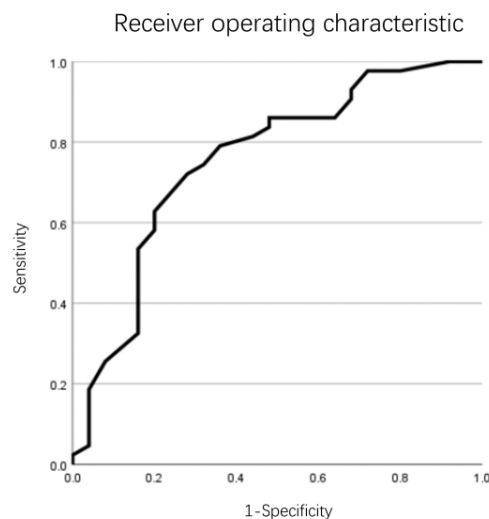


Figure 3. Receiver operating characteristic curve analysis of the prediction model derived from multivariable regression results.

4. Discussion

Postoperative UI remains a significant complication affecting quality of life in patients undergoing RARP[14]. Its multifactorial etiology includes intraoperative trauma to pelvic structures, urinary sphincter complex, and neural components[30]. While prior research has explored surgical and anatomical risk factors, our study adds novel insights into the predictive role of neurophysiological parameters, particularly the BCR latency, in early continence recovery.

Needle EMG provides precise assessment of

muscle and associated neural circuitry, where MUP parameters (duration, amplitude) traditionally aid in diagnosing neuromuscular pathology. Unlike static MUP measurements, BCR latency serves as a dynamic indicator of sacral reflex arc integrity (S2–S4)[31,32]. Our findings indicate that prolonged BCR latency—reflecting delayed conduction through afferent, central, and efferent pathways—is an independent predictor of UI severity. Interestingly, while both the bulbocavernosus and external US share efferent innervation via the perineal branch of the pudendal nerve[33,34], only BCR latency

differentiated between UI severity groups, whereas MUP metrics did not. This suggests that synaptic efficiency and reflex circuit integrity (rather than muscle or peripheral nerve status alone) may critically influence early continence recovery.

Our findings support existing evidence that advanced age independently predicts poorer urinary continence recovery after prostatectomy, likely due to age-related declines in pelvic muscle function, urethral sphincter integrity, and tissue repair capacity. This aligns with prior large-scale research (N=2,849), which established age as an independent predictor of poorer continence outcomes at both 6 and 12 months postoperatively[30]. Although nerve-sparing techniques showed a clinically meaningful association with UI severity in our cohort analysis (84% preservation in mild UI vs. 58% in severe cases), this factor did not emerge as an independent predictor in our model, possibly due to interactions with surgical expertise or baseline patient factors. Nevertheless, the consistent clinical benefit of NVB preservation remains supported by meta-analytic evidence²¹ and should continue to inform surgical decision-making[35]. From a mechanistic perspective, the incomplete understanding of NVB's role in continence – especially regarding its autonomic contributions to urethral function beyond erectile pathways – highlights a critical knowledge gap[36]. Future studies should investigate whether neurovascular bundle integrity primarily influences continence through neural signaling, vascular perfusion, or both, potentially using advanced intraoperative neuromonitoring techniques[37]. Clinically, these findings emphasize: the importance of age-specific preoperative counseling to align patient expectations with likely recovery timelines; the need for tailored rehabilitation protocols addressing older adults' unique pelvic floor adaptation challenges. The exclusion of NVB status from our predictive model should be interpreted with caution, as it may reflect study limitations rather than true biological insignificance, given robust mechanistic evidence supporting its role in continence preservation.

The correlation between BCR latency and UI severity raises the provocative possibility of intraoperative neuromonitoring during RARP.

While BCR monitoring has successfully reduced voiding dysfunction in spinal surgery its utility in prostatectomy remains controversial[38-40]. Won et al reported positive result in the phase I/II clinical trial of intraoperative cavernous nerve monitoring in RARP[41]. But another more recent study failed to demonstrate improved continence or erectile outcomes[42]. Our regression analysis identified BCR latency as significantly associated with postoperative UI severity. This finding suggests potential utility in monitoring BCR pathways (pudendal/perineal nerves) during RP as prognostic indicators. Whereas the temporal delay between intraoperative injury and clinical manifestation may complicate real-time interpretation, the electrophysiological data provide objective risk stratification. Further validation studies remain essential to establish the clinical viability of this approach.

Our investigation had several notable limitations. The invasive and uncomfortable nature of needle EMG led to considerable participant dropout, ultimately limiting our sample size. Additionally, postoperative urinary incontinence symptoms naturally fluctuate over time. While serial EMG evaluations could have provided valuable comparisons with preoperative baselines, logistical constraints prevented such longitudinal assessments. These limitations underscore the need for future multicenter studies with larger cohorts and standardized follow-up protocols to better evaluate the temporal relationship between EMG parameters and functional outcomes.

In conclusion, this study establishes that preoperative BCR latency and age constitute a clinically viable model (AUC=0.755) for predicting early UI severity post-RARP. By integrating neurophysiological metrics into risk stratification, we offer a novel paradigm for personalized preoperative counseling and targeted rehabilitation. Future work should explore intraoperative neuroprotection strategies and the longitudinal evolution of electrophysiological markers in continence recovery.

5. Conclusions

Our study identified older age and prolonged BCR latency as independent predictors of higher UI severity one month after RARP. The nerve-sparing surgical technique was protective against severe UI, emphasizing its clinical importance.

We developed and validated a prediction model (AUC = 0.755) incorporating age and BCR latency to stratify patients at risk of postoperative incontinence, offering clinicians a tool for early intervention strategies. These findings suggest that neurophysiological factors (such as nerve conduction function) play a significant role in early UI recovery and should be considered in patient counseling and surgical planning. Future studies should focus on longer-term validation of this model and explore mechanistic links between age, BCR latency, and postoperative continence outcomes.

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Institutional Review Board Statement: The study protocol received ethical approval from the Institutional Review Board of Sir Run Run Shaw Hospital (Approval No. 2022-0208).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Due to privacy legislation, we are unavailable to provide the full data.

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References

- Ding, L.F.; Wang, R.Y.; Shen, D.Y.; Cheng, S.; Wang, H.; Lu, Z.Y.; Zheng, Q.M.; Wang, L.Y.; Xia, L.Q.; Li, G.H. Role of noncoding RNA in drug resistance of prostate cancer. *Cell Death Dis.* 2021, *12*, doi:10.1038/s41419-021-03854-x.
- Culp, M.B.; Soerjomataram, I.; Efstathiou, J. A.; Bray, F.; Jemal, A. Recent Global Patterns in Prostate Cancer Incidence and Mortality Rates. *Eur. Urol.* 2020, *77*, 38-52, doi:10.1016/j.eururo.2019.08.005.
- Liu, J.; Dong, L.; Zhu, Y.; Dong, B.; Sha, J.; Zhu, H.H.; Pan, J.; Xue, W. Prostate cancer treatment - China's perspective. *Cancer Lett.* 2022, *550*, 215927, doi:10.1016/j.canlet.2022.215927.
- Sung, H.; Ferlay, J.; Siegel, R.L.; Laversanne, M.; Soerjomataram, I.; Jemal, A.; Bray, F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA. Cancer J. Clin.* 2021, *71*, 209-249, doi:10.3322/caac.21660.
- Costello, A.J. Considering the role of radical prostatectomy in 21st century prostate cancer care. *Nat. Rev. Urol.* 2020, *17*, 177-188, doi:10.1038/s41585-020-0287-y.
- Mohan, R.; Schellhammer, P.F. Treatment options for localized prostate cancer. *Am. Fam. Physician* 2011, *84*, 413-420.
- Guillonnet, B.; Cathelineau, X.; Barret, E.; Rozet, F.; Vallancien, G. Laparoscopic radical prostatectomy: technical and early oncological assessment of 40 operations. *Eur. Urol.* 1999, *36*, 14-20, doi:10.1159/000019921.
- Ma, J.; Xu, W.; Chen, R.; Zhu, Y.; Wang, Y.; Cao, W.; Ju, G.; Ren, J.; Ye, X.; He, Q.; et al. Robotic-assisted versus laparoscopic radical prostatectomy for prostate cancer: the first separate systematic review and meta-analysis of randomized controlled trials and non-randomised studies. *Int. J. Surg.* 2023, *109*, 1350-1359, doi:10.1097/JS9.000000000000193.
- Huang, X.; Wang, L.; Zheng, X.M.; Wang, X.H. Comparison of perioperative, functional, and oncologic outcomes between standard laparoscopic and robotic-assisted radical prostatectomy: a systemic review and meta-analysis. *Surg. Endosc.* 2017, *31*, 1045-1060, doi:10.1007/s00464-016-5125-1.
- Ficarra, V.; Caverri, S.; Nouara, G.; Aragona, M.; Artibani, W. Evidence from robot-assisted laparoscopic radical prostatectomy: A systematic

- tic review. *Eur. Urol.* 2007, *51*, 45-56, doi:10.1016/j.eururo.2006.06.017.
11. Du, Y.F.; Long, Q.Z.; Guan, B.; Mu, L.J.; Tian, J.H.; Jiang, Y.M.; Bai, X.J.; Wu, D.P. Robot-Assisted Radical Prostatectomy Is More Beneficial for Prostate Cancer Patients: A Systematic Review and Meta-Analysis. *Med. Sci. Monit.* 2018, *24*, 272-287, doi:10.12659/MSM.907092.
 12. Gandaglia, G.; Sammon, J.D.; Chang, S.L.; Choueiri, T.K.; Hu, J.C.; Karakiewicz, P.I.; Kibel, A.S.; Kim, S.P.; Konijeti, R.; Montorsi, F.; et al. Comparative Effectiveness of Robot-Assisted and Open Radical Prostatectomy in the Post-dissemination Era. *J. Clin. Oncol.* 2014, *32*, 1419-+, doi:10.1200/Jco.2013.53.5096.
 13. Straczynska, A.; Weber-Rajek, M.; Strojek, K.; Piekorz, Z.; Styczynska, H.; Goch, A.; Radziminska, A. The Impact Of Pelvic Floor Muscle Training On Urinary Incontinence In Men After Radical Prostatectomy (RP) - A Systematic Review. *Clin. Interv. Aging* 2019, *14*, 1997-2005, doi:10.2147/Cia.S228222.
 14. Loughlin, K.R.; Prasad, M.M. Post-Prostatectomy Urinary Incontinence: A Confluence of 3 Factors. *J. Urol.* 2010, *183*, 871-877, doi:10.1016/j.juro.2009.11.011.
 15. Sallami, S. Predictive factors of urinary incontinence after radical prostatectomy: Systematic review. *Tunis. Med.* 2017, *95*, 229-235.
 16. Tutolo, M.; Montorsi, F. Anatomical predictors of long-term urinary incontinence after robot-assisted laparoscopic prostatectomy: A systematic review. *Neurourol. Urodyn.* 2021, *40*, 2053-2054, doi:10.1002/nau.24769.
 17. Sahin, N.; Yesil, H.; Gorcan, B. The effect of pelvic floor exercises performed with EMG biofeedback or a vaginal cone on incontinence severity, pelvic floor muscle strength, and quality of life in women with stress urinary incontinence: a randomized, 6-month follow-up study. *Int. Urogynecol. J.* 2022, *33*, 2773-2779, doi:10.1007/s00192-021-05006-3.
 18. Yu, C.; Xu, L.; Ye, L.; Zheng, Q.; Hu, H.; Ni, K.; Zhou, C.; Xue, D.; Cheng, S.; Wang, H.; et al. Single-port robot-assisted perineal radical prostatectomy with the da Vinci XI system: initial experience and learning curve using the cumulative sum method. *World J. Surg. Oncol.* 2023, *21*, 46, doi:10.1186/s12957-023-02927-9.
 19. Geng, E.K.; Yin, S.F.; Yang, Y.L.; Ke, C.X.; Fang, K.W.; Liu, J.H.; Wang, D.Q. The effect of perioperative pelvic floor muscle exercise on urinary incontinence after radical prostatectomy: a meta-analysis. *Int. Braz. J. Urol.* 2023, *49*, 441-451, doi:10.1590/S1677-5538.Ibju.2023.0053.
 20. Podnar, S.; Vodusek, D.B. Protocol for clinical neurophysiologic examination of the pelvic floor. *Neurourol. Urodyn.* 2001, *20*, 669-682, doi:DOI 10.1002/nau.1018.
 21. Molina, R.A.P.; Vázquez, S.M.; Galiano, J.M.M.; Izquierdo, M.R.; Khan, K.S.; Cano-Ibáñez, N. Prevalence of depression and anxiety in women with pelvic floor dysfunctions: A systematic review and meta-analysis. *Int. J. Gynaecol. Obstet.* 2024, *167*, 507-528, doi:10.1002/ijgo.15719.
 22. Zhu, X.Y.; Hu, M.Y.; Song, H.X.; Dai, J.; Zhang, Y.; Zhuang, Y.Y. Effect of Pelvic Floor Biofeedback with Electrical Stimulation and Resistance-Based Thigh Adduction Training on Postpartum Stress Urinary Incontinence. *Chin. J. Med. Rehabil.* 2024, *46*, 644-647, doi:10.3760/cma.j.issn.0254-1424.2024.07.013. [in Chinese].
 23. Li, M.; Dong, X.D.; Lyu, Q.; Li, P.P.; Lyu, Y.; Zhang, G.F.; Gai, T.Z.; Feng, Q.; Yang, C.X.; Liang, Y.X. Two year follow-up and comparison of pelvic floor muscle electromyography after first vaginal delivery with and without episiotomy and its correlation with urinary incontinence: A prospective cohort study. *Acta Obstet. Gynecol. Scand.* 2023, *102*, 200-208, doi:10.1111/aogs.14487.
 24. Daube, J.R.; Rubin, D.I. Needle Electromyography. *Muscle Nerve* 2009, *39*, 244-270, doi:10.1002/mus.21180.
 25. Huang, J.G.; Dai, X.W.; Sun, J.; Fan, Y.; Guo, C. Prediction models for urinary incontinence after robotic-assisted laparoscopic radical prostatectomy: a systematic review. *J. Robot. Surg.* 2024, *18*, doi:10.1007/s11701-024-02009-2.
 26. Pinkhasov, R.M.; Lee, T.; Huang, R.; Berkley, B.; Pinkhasov, A.M.; Dodge, N.; Loecher, M.S.; James, G.; Pop, E.; Attwood, K.; Mohler, J.L. Prediction of Incontinence after Robot-Assisted Radical Prostatectomy: Development and Validation of a 24-Month Incontinence Nomogram. *Cancers* 2022, *14*, doi:10.3390/cancers14071644.
 27. Martini, A.; Falagario, U.G.; Villers, A.; Dell'Oglio, P.; Mazzone, E.; Autorino, R.; Moschos, M.C.; Buscarini, M.; Bravi, C.A.; Briganti, A.; et al. Contemporary Techniques of Prostat

- e Dissection for Robot-assisted Prostatectomy. *Eur. Urol.* 2020, 78, 583-591, doi:10.1016/j.euro.2020.07.017.
28. Rubin, D.I. Needle Electromyography Waveforms During Needle Electromyography. *Neurol. Clin.* 2021, 39, 919-938, doi:10.1016/j.ncl.2021.06.003.
 29. Yaxley, J.W.; Coughlin, G.D.; Chambers, S. K.; Occhipinti, S.; Samaratunga, H.; Zajdlewicz, L.; Dungleison, N.; Carter, R.; Williams, S.; Payton, D.J.; et al. Robot-assisted laparoscopic prostatectomy versus open radical retropubic prostatectomy: early outcomes from a randomised controlled phase 3 study. *Lancet* 2016, 388, 1057-1066, doi:10.1016/S0140-6736(16)30592-X.
 30. Heesakkers, J.; Farag, F.; Bauer, R.M.; Sandhu, J.; De Ridder, D.; Stenzl, A. Pathophysiology and Contributing Factors in Postprostatectomy Incontinence: A Review. *Eur. Urol.* 2017, 71, 936-944, doi:10.1016/j.euro.2016.09.031.
 31. Skinner, S.A.; Vodusek, D.B. Intraoperative recording of the bulbocavernosus reflex. *J. Clin. Neurophysiol.* 2014, 31, 313-322, doi:10.1097/WNP.0000000000000054.
 32. Blaiivas, J.G.; Zayed, A.A.; Labib, K.B. The bulbocavernosus reflex in urology: a prospective study of 299 patients. *J. Urol.* 1981, 126, 197-199, doi:10.1016/s0022-5347(17)54445-6.
 33. Yang, C.C.; Bradley, W.E. Reflex innervation of the bulbocavernosus muscle. *BJU Int.* 2000, 85, 857-863, doi:10.1046/j.1464-410x.2000.00560.x.
 34. Nyangoh Timoh, K.; Moszkowicz, D.; Creze, M.; Zaitouna, M.; Felber, M.; Lebacle, C.; Dillio, D.; Martinovic, J.; Tewari, A.; Lavoue, V.; et al. The male external urethral sphincter is anatomically innervated. *Clin. Anat.* 2021, 34, 263-271, doi:10.1002/ca.23698.
 35. Nguyen, L.N.; Head, L.; Witiuk, K.; Punjani, N.; Mallick, R.; Cnossen, S.; Fergusson, D.A.; Cagiannos, I.; Lavalley, L.T.; Morash, C.; Breau, R.H. The Risks and Benefits of Cavernous Neurovascular Bundle Sparing during Radical Prostatectomy: A Systematic Review and Meta-Analysis. *J. Urol.* 2017, 198, 760-769, doi:10.1016/j.juro.2017.02.3344.
 36. Walsh, P.C.; Donker, P.J. Impotence Following Radical Prostatectomy: Insight into Etiology and Prevention. *J. Urol.* 2017, 197, S165-S170, doi:10.1016/j.juro.2016.10.105.
 37. Steineck, G.; Bjartell, A.; Hugosson, J.; Axen, E.; Carlsson, S.; Stranne, J.; Wallerstedt, A.; Persson, J.; Wilderang, U.; Thorsteinsdottir, T.; et al. Degree of preservation of the neurovascular bundles during radical prostatectomy and urinary continence 1 year after surgery. *Eur. Urol.* 2015, 67, 559-568, doi:10.1016/j.euro.2014.10.011.
 38. Cha, S.; Wang, K.C.; Park, K.; Shin, H.I.; Lee, J.Y.; Chong, S.; Kim, K. Predictive value of intraoperative bulbocavernosus reflex during urethral surgery for post-operative voiding function. *Clin. Neurophysiol.* 2018, 129, 2594-2601, doi:10.1016/j.clinph.2018.09.026.
 39. Choi, J.; Kim, J.S.; Hyun, S.J.; Kim, K.J.; Park, K.S. Efficacy of intraoperative bulbocavernosus reflex monitoring for the prediction of postoperative voiding function in adult patients with lumbosacral spinal tumor. *J. Clin. Monit. Comput.* 2022, 36, 493-499, doi:10.1007/s10877-021-00678-0.
 40. Yang, T.; Jin, K.; Kong, D.; Wang, Y.; Lu, J.; Liu, X. Intraoperative bulbocavernosus reflex monitoring for predicting postoperative voiding dysfunction in patients with distal intraspinal tumors. *J. Clin. Neurosci.* 2024, 129, 110865, doi:10.1016/j.jocn.2024.110865.
 41. Song, W.H.; Park, J.H.; Tae, B.S.; Kim, S.M.; Hur, M.; Seo, J.H.; Ku, J.H.; Kwak, C.; Kim, H.H.; Kim, K.; Jeong, C.W. Establishment of Novel Intraoperative Monitoring and Mapping Method for the Cavernous Nerve During Robot-assisted Radical Prostatectomy: Results of the Phase I/II, First-in-human, Feasibility Study. *Eur. Urol.* 2020, 78, 221-228, doi:10.1016/j.euro.2019.04.042.
 42. Nolsoe, A.B.; Ostergren, P.B.; Jakobsen, H.; Jensen, C.F.S.; Bruun, N.H.; Sonksen, J.; Fode, M. Can nerve monitoring during radical prostatectomy improve functional outcomes? A randomised trial. *BJU Int.* 2024, 133, 742-751, doi:10.1111/bju.16295.

Abbreviations

The following abbreviations are used in this manuscript:

UI	urinary incontinence
BCR	bulbocavernosus reflex
NVB	neurovascular bundle
RARP	robot-assisted radical prostatectomy
EMG	pelvic floor electromyography
ICI-Q-SF	International Consultation on Incontinence Questionnaire–Short Form
AUC	areas under the curves
PCa	Prostate cancer
ORP	open radical prostatectomy
LRP	laparoscopic radical prostatectomy
PSM	positive surgical margins
ED	erectile dysfunction
PFMT	pelvic floor muscle training
PFM	pelvic floor muscle
PFD	pelvic floor dysfunction
IPSS	International Prostate Symptom Score
US	urethral sphincter
IQRs	interquartile ranges