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Original Article

Effects of neoadjuvant novel endocrine therapy combined with prostatic artery embolization on SII, PNI, and bRFS in patients with prostate cancer

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Abstract: Objective: To investigate the effects of neoadjuvant novel endocrine therapy combined with prostatic artery embolization (PAE) on systemic immune-inflammation index (SII), prognostic nutritional index (PNI), and biochemical recurrence-free survival (bRFS) in patients with high-risk or locally advanced prostate cancer, and to evaluate the feasibility of SII/PNI as early prognostic biomarkers. Methods: A retrospective analysis was conducted on 339 patients treated between Feb 2019 and Mar 2023, including 174 patients in the combination group (endocrine therapy + PAE) and 165 in the control group (endocrine therapy alone). PSA50/PSA90 response rates, surgical conversion rate, and changes in SII and PNI at 1 and 3 months after treatment were compared between the two groups. Kaplan-Meier analysis was used to evaluate bRFS, and time-dependent receiver operating characteristic (ROC) curves were applied to assess the predictive value of SII and PNI for 1- and 2-year bRFS. Results: The combination group demonstrated significantly higher PSA50/PSA90 response rates ($P<0.05$), higher surgical conversion rate (66.7% vs. 42.4%, $P<0.001$), greater reductions in SII (≥30%: 83.3% vs. 64.2%), and more pronounced PNI improvement (≥45: 82.9% vs. 69.7%, $P<0.01$) compared with the control group. The 1- and 2-year bRFS rates increased by 8.4% and 11.2%, respectively ($P<0.05$). SII and PNI measured at 3 months showed good predictive performance for bRFS, with AUC values ranging from 0.73 to 0.83. Survival analysis based on SII/PNI stratification revealed significant differences between groups ($P<0.05$). Conclusion: The combined regimen accelerates PSA reduction, improves surgical feasibility, and alleviates systemic inflammation and nutritional status. SII/PNI detection at 3 months may facilitate early identification of recurrence risk and guide individualized treatment adjustment.

Keywords: Neoadjuvant endocrine therapy, prostate artery embolization (PAE), systemic immune-inflammation index (SII), prognostic nutritional index (PNI), biochemical recurrence-free survival (bRFS)

Introduction

Prostate cancer is one of the most commonly diagnosed malignancies among middle-aged and elderly men, and its global incidence and mortality rates have been continuously rising (approximately 1.4 million new cases and 375,000 deaths reported in 2020) [1-3]. For patients with locally advanced or high-risk prostate cancer, radical prostatectomy combined with radiotherapy and endocrine therapy is the standard treatment regimen currently. However, this "triple-modality" has several limitations: high-risk tumors are prone to invading neurovascular bundles, leading to a high rate of positive surgical margins. In addition, endocrine therapy alone is prone to the development of drug resistance, resulting in a high risk of postoperative recurrence and metastasis [4-6]. Therefore, the exploration of more effective and safer combination treatment models, as well as the optimization of neoadjuvant treatment strategies, has become a key focus in current prostate cancer research.

The primary goal of neoadjuvant therapy is to achieve tumor downstaging and lesion shrinkage through preoperative intervention, thereby

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facilitating subsequent treatment [7]. In recent years, novel endocrine therapy drugs have demonstrated significant advantages in prostate cancer treatment due to their more potent androgen suppression and higher tumor cell selectivity. When used in neoadjuvant therapy, these drugs can effectively inhibit tumor proliferation and improve both resectability and tumor control effect [8]. At the same time, prostatic artery embolization (PAE), as a minimally invasive interventional therapy, reduces tumor blood supply by embolizing the tumor-feeding arteries, thereby inducing tumor volume reduction and suppressing tumor activity. Owing to its minimal invasiveness and favorable tolerability, PAE offers a new direction for combined treatment models [9]. However, the combined application of these two treatment methods in neoadjuvant therapy for prostate cancer remains at an early stage, and their clinical efficacy and underlying mechanisms need further verification.

In recent years, peripheral blood-based biomarkers, including the systemic immune-inflammation index (SII) and prognostic nutritional index (PNI), have attracted increasing attention due to their low cost and good reproducibility. Elevated SII indicates an enhanced systemic inflammatory response, often driven by platelet-mediated tumor-promoting effects, whereas decreased PNI reflects impaired nutritional and immune status. Both indices have been shown to be associated with poor prognosis in a variety of solid tumors [10, 11]. However, no studies to date have systematically evaluated the dynamic changes in SII and PNI after intervention with novel endocrine therapy or PAE, nor whether these two indicators can be used as early surrogate markers for biochemical recurrence-free survival (bRFS). Clarifying this issue will not only fill the research gap in the field of neoadjuvant therapy for prostate cancer but also provide an effective tool for patient stratification in future combination strategies, including immunotherapy.

Based on these considerations, this study aimed to investigate the effects of neoadjuvant novel endocrine therapy combined with PAE on SII, PNI, and bRFS in patients with prostate cancer, and to clarify the clinical efficacy and prognostic significance of this combined treatment regimen.

Methods

General information

This retrospective study included 339 patients with prostate cancer who were treated at the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine and Tangdu Hospital between February 2019 and March 2023. According to the preoperative treatment regimens, 165 patients received neoadjuvant novel endocrine therapy alone (control group), while 174 patients underwent additional PAE based on endocrine therapy (combination group). The study protocol was approved by the Ethics Committee of the Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, and all procedures were conducted in accordance with medical ethics standards.

Treatment protocols

Neoadjuvant Endocrine Therapy: All patients received novel androgen receptor pathway inhibitors (ARPIs). Specifically, 128 patients in the combination group and 120 in the control group received oral enzalutamide (160 mg once daily); the remaining patients received oral abiraterone acetate (1,000 mg once daily) combined with prednisone (5 mg once daily). Treatment was initiated at enrollment and continued until the day prior to surgery or for at least 3 months in patients who did not undergo surgery.

Prostatic Artery Embolization (PAE): Patients in the combination group underwent PAE within one week after endocrine therapy initiation. The procedure was performed via femoral artery access under local anesthesia. After super-selective catheterization of the prostatic arteries confirmed by angiography, embolization was carried out using 100-300 μm Embosphere microspheres (Merit Medical) until near-stasis of blood flow in the prostatic arterial branches was achieved (subtotal embolization). Technical success was defined as successful embolization of all identified prostatic arteries. To objectively evaluate embolization efficacy, pelvic contrast-enhanced MRI or CT was routinely performed 1 month after PAE. Successful embolization was defined according to the following criteria: (1) disappearance or marked reduction (>70%) of contrast enhancement in the embolized prostatic arterial territo-

ry; (2) reduction of intraprostatic perfusion signals compared with baseline imaging; (3) absence of early arterial-phase tumor staining.

Criteria for case collection

Inclusion criteria: ① Prostate adenocarcinoma confirmed by needle biopsy; ② Locally advanced or high-risk disease at initial diagnosis, as determined by T stage, prostate-specific antigen (PSA) level, and Gleason score; ③ Availability of complete medical records and follow-up data.

Exclusion criteria: ① Concurrent other malignant tumors; ② Prior history of prostate cancer treatment; ③ Severe organic disease, coagulation disorders, or active infection precluding tolerance of therapy.

Data collection

Baseline clinical data: Baseline clinical data were collected for all patients before treatment. Demographic characteristics included age (grouped as <65 years, ≥65 years) and body mass index (BMI); Tumor-related indicators included PSA level, Gleason score (grouped as <8, ≥8), tumor stage (T/N/M stage, determined based on CT, MRI imaging, and bone scan results), prostate volume (measured by ultrasound or MRI), maximum tumor diameter (assessed by imaging), and the presence of bone metastasis. Comorbidities, including hypertension and diabetes, were also recorded.

Laboratory parameters: To evaluate systemic immune-inflammatory and nutritional status, peripheral blood samples were collected at three predefined time points: before treatment, 1 month after treatment, and 3 months after treatment. Based on routine blood and biochemical test data, the following indices were calculated: systemic immune-inflammation index (SII) = (platelet × neutrophil)/lymphocyte; prognostic nutritional index (PNI) = serum albumin + 5 × lymphocyte count. PSA levels were measured using chemiluminescence immunoassay, based on which the achievement of PSA50 (≥50% decrease from baseline) and PSA90 (≥90% decrease from baseline) was determined. All peripheral blood samples were collected in the morning after overnight fasting at each predefined time point. Laboratory analyses were completed within 2 hours after sampling to minimize measurement variability.

Efficacy evaluation: The surgical resection rate was determined based on operative records, and the proportion of patients who successfully completed tumor resection was calculated.

Safety assessment and PAE-related complications: Procedure-related complications were recorded during hospitalization and follow-up, including puncture-site bleeding, hematoma, vascular injury, infection, transient urinary retention, pelvic pain, and non-target embolization. Complications were graded according to the Society of Interventional Radiology (SIR) classification system.

Follow-up and prognosis indicators: Patients were followed up via a combination of outpatient visits and telephone interviews. The primary endpoint was biochemical recurrence-free survival (bRFS), defined as the time from treatment initiation to the occurrence of biochemical recurrence. Biochemical recurrence was defined as follows: after radical surgery, a PSA level ≥0.2 ng/ml with a confirmatory rise; or after radiotherapy, an increase in PSA of >2 ng/ml from its lowest value. Additionally, 1-year and 2-year bRFS rates were recorded.

Statistical analysis

Data analysis was conducted using SPSS 26.0 (IBM) and R software (version 4.2.2). The normality of continuous variables was assessed using the Shapiro-Wilk test; variables with a skewed distribution were presented as median (interquartile range, IQR) and were compared using the Mann-Whitney U test. Categorical variables were expressed as counts (percentages), and inter-group differences were examined using the chi-square test or Fisher's exact test, as appropriate. bRFS was estimated using the Kaplan-Meier method, and differences between groups were compared using the Log-rank test. To evaluate the independent association between treatment modality and bRFS, multivariate Cox proportional hazards regression analysis was performed, adjusting for age, baseline PSA, Gleason score, clinical T stage, and the presence of bone metastasis.

Tumor differentiation grade was not entered into the multivariate Cox model due to significant collinearity with Gleason score (variance inflation factor >5), and Gleason score was retained as the more clinically established prognostic parameter. The predictive performance

of SII and PNI at 3 months for bRFS was evaluated using time-dependent receiver operating characteristic (ROC) curves. A *P*-value < 0.05 was considered statistically significant.

Results

Baseline characteristics

To ensure comparability between groups, baseline data were first analyzed. As shown in **Table 1**, the combination group and the control group were balanced in key variables, including age, BMI, baseline PSA level, Gleason score, clinical stage, and prostate volume (all P>0.05).

Treatment efficacy

The PSA50 achievement rates at post-treatment 1 month and 3 months in the combination group were significantly higher than the control group (75.9% vs. 62.4%, P=0.016; 84.5% vs. 71.2%, P=0.024, respectively). Notably, the combination group demonstrated a more pronounced advantage in PSA90 achievement rate (1 month: 54.0% vs. 37.0%, P=0.002; 2 months: 68.4% vs. 48.5%, P=0.002). This enhanced treatment response ultimately translated into a significantly higher rate of conversion to radical surgery in the combination group compared with the control group (66.7% vs. 42.4%; P<0.001) (**Figure 1**).

Changes in SII before and after treatment

Before treatment, there was no significant difference in the baseline SII between the two groups (P>0.05). Following treatment, the combination group exhibited a significantly greater reduction in SII compared with the control group at both 1 month and 3 months (P=0.001, P<0.001). Furthermore, the proportion of patients with an SII reduction of ≥30% was also significantly higher in the combination group (P<0.001). The details are shown in **Table 2**.

Changes in PNI before and after treatment

There was no significant difference in baseline PNI between the two groups (P>0.05). However, patients in the combination group showed a significantly improved nutritional status after treatment. At 1-month post-treatment, PNI values of the combination group were significantly higher than the control group (P=0.044), and this difference became more pronounced at 3 months (P<0.001). Additionally, the proportion of patients with a PNI≥45 in the combined group was significantly higher than the control group (P=0.004), indicating a greater overall improvement in nutritional status. The details are shown in **Table 3**.

Comparison of prognosis between the two groups

Survival analysis showed that combined treatment significantly delayed biochemical recurrence. At 1 year and 2 years after treatment, the cumulative numbers of recurrence cases in the control group were 17 and 35, respectively, while the numbers in the combination group were only 8 and 21, respectively. Kaplan-Meier analysis (**Figure 2**) showed that the estimated 1-year bRFS rate was 95.4% (95% CI: 91.8-98.9%) in the combination group and 89.7% (95% CI: 84.6-94.8%) in the control group (P= 0.039). At 2 years, the corresponding bRFS rate was 87.9% (95% CI: 82.1-93.7%) in the combination group, compared with 76.7% (95% CI: 69.9-83.5%) in the control group (P=0.021).

Predictive value of post-treatment SII and PNI for prognosis

Time-dependent ROC curves were plotted to evaluate the predictive performance of SII and PNI at 3 months for 1- and 2-year bRFS in both groups (**Figure 3**). For 1-year bRFS prediction, SII at 3 months showed good discriminative ability in both groups, (AUC=0.779, 0.784). PNI at the same timepoint exhibited slightly better predictive performance than SII, with AUC values of 0.795 in the combination group and 0.824 in the control group. For 2-year bRFS prediction, SII at 3 months remained predictive (AUC=0.746, 0.731). PNI similarly demonstrated stable predictive performance, with AUCs of 0.737 and 0.745 in the combination and control groups, respectively.

Impact of SII and PNI levels on 1- and 2-year bRFS

Based on the optimal cut-off values determined by ROC analysis at the 3-month time point, patients were divided into high- and low-level groups for both SII and PNI. Survival analysis confirmed that patients with high SII levels had significantly lower 1-year and 2-year bRFS rates (P<0.05); in contrast, patients with high PNI lev-

Table 1. Comparison of baseline characteristics between the two groups

	Combined group (n=174)	Control group (n=165)	t/χ^2	P
Age (years)			0.304	0.581
<65	79	70		
≥65	95	95		
BMI (kg/m^2)	24.82±3.14	24.67±3.36	0.425	0.671
PSA (ng/mL)	39.53±9.76	38.19±9.48	1.281	0.201
Gleason Score			0.889	0.346
<8	86	90		
≥8	88	75		
T Stage			0.867	0.352
T1-T3	84	88		
T4	90	77		
N Stage			0.356	0.551
N0	61	63		
N1	113	102		
M Stage			0.998	0.318
M0	76	81		
M1	98	84		
Prostate Volume (cm^3)	50.74±8.56	51.43±8.27	0.754	0.451
Maximum Tumor Diameter (cm)	4.22±1.12	4.36±1.05	1.186	0.237
Bone Metastasis			1.063	0.303
Present	92	78		
Absent	82	87		
Tumor differentiation			0.480	0.787
Well-differentiated	34	29		
Moderately differentiated	98	99		
Poorly differentiated	42	37		
Hypertension			0.719	0.869
Non-hypertensive	116	105		
Grade 1 hypertension	21	23		
Grade 2 hypertension	30	28		
Grade 3 hypertension	7	9		
Diabetes mellitus			0.916	0.633
Non-diabetic	148	134		
Diabetic (HbA1c<7%)	18	22		
Diabetic (HbA1c≥7%)	8	9		

Note: BMI: Body mass index, PSA: prostate-specific antigen, HbA1c: hemoglobin A1c.

els had significantly higher bRFS rates (P<0.05), as shown in **Figure 4**.

PAE-related complications

In the combination group, PAE was technically successful in 170 of 174 patients (97.77%). Procedure-related complications were generally mild. Puncture-site hematoma occurred in 6 patients (3.45%), transient pelvic pain in 11 patients (6.32%), and transient dysuria in 9 patients (5.17%). No severe complications, such as major vascular injury, prostate abscess, or treatment-related death, were observed.

Subgroup analysis

To further explore the efficacy of combination therapy in different risk populations, subgroup analyses were performed based on the presence of bone metastasis and Gleason score (≥8). In both the bone metastasis and non-

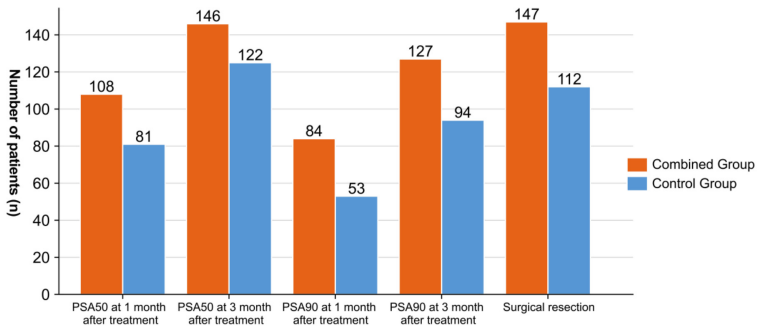

Figure 1. Comparison of therapeutic efficacy between the two groups. Note: Prostate-specific antigen (PSA).

metastasis subgroups, the PSA90 achievement rate at 3 months and the rate of conversion to radical surgery were significantly higher in the combination group than in the control group (all $P<0.05$). Similarly, among patients with Gleason score ≥8, the combination group also showed superior PSA90 response rate (65.9% vs. 46.7%, $P=0.012$) and a higher rate of conversion to radical surgery (63.6% vs. 41.3%, $P=0.003$). These findings suggest that the therapeutic benefit of the combination therapy is consistent across high-risk subgroups.

Discussion

This study demonstrated that the neoadjuvant novel endocrine therapy combined with PAE achieved significantly better PSA response, higher rates of conversion to radical surgery, greater reductions in SII, more pronounced improvements in PNI, and superior 1- and 2-year bRFS compared with the neoadjuvant novel endocrine therapy alone. These findings provide important clinical evidence for optimizing neoadjuvant strategies and preliminarily support the potential role of SII and PNI as dynamic prognostic indicators.

The therapeutic advantage of the combination therapy was reflected in higher PSA50/PSA90 response rates and markedly increased rate of conversion to radical surgery. At 1 and 3 months after treatment, PSA50 response rates were consistently higher in the combination group, and a similar trend was observed for PSA90. In addition, a greater proportion of patients in the combination group proceeded to definitive surgical treatment. These findings suggest that potent androgen-receptor pathway inhibition by neoadjuvant novel hormonal therapy curbs tumor proliferation, whereas PAE-induced ischemic necrosis further reduces tumor volume. This synergistic effect may contribute to improved local disease control. Similar findings were reported by Haddad et al. [12], who demonstrated that neoadjuvant PAE significantly reduced prostate volume and was associated with lower post-operative PSA levels. Compared with the study by Haddad et al., which primarily employed smaller embolic particles and partial arterial occlusion, the present study adopted 100-300 μm calibrated microspheres to achieve near-stasis embolization. This more complete devascularization may partly explain the greater PSA decline and higher rate of conversion to radical surgery observed in our cohort. In addition, Burkhardt et al. [13] confirmed the safety and functional benefits of PAE in patients with advanced disease, supporting the feasibility of this combination. The potential synergistic effect may be related to the hypoxic milieu created by embolization, which could enhance sensitivity to hormonal therapy while simultaneously impairing nutrient supply and angiogenic signaling. While PAE has been validated for the management of lower-urinary-tract symptom [14], its integration with neoadjuvant novel hormonal therapy in high-risk or locally advanced prostate cancer remains insufficiently explored. This study provides preliminary evidence supporting this combined strategy, which may help overcome limitations of traditional hormonal therapy and improve surgical feasibility.

SII and PNI, as inexpensive peripheral blood-based biomarkers, demonstrated clinically meaningful dynamic changes. The observed reduction in SII and elevation in PNI likely reflect intertwined biological processes. PAE, by inducing ischemia within the tumor microenvironment, may directly reduce the release of pro-inflammatory cytokines, thereby attenuating systemic inflammation as reflected by SII. Concurrently, novel endocrine therapy, through profound inhibition of the androgen receptor signaling pathway, suppresses tumor proliferation and may also modulate immune cell function. Androgen deprivation has been reported

Table 2. Comparison of SII between the two groups before and after treatment

	Before treatment	1 month after treatment	3 months after treatment	SII decrease≥30%
Combined group (n=174)	899.89±251.33	735.96±217.98	461.37±159.11	145 (83.33)
Control group (n=165)	928.19±296.35	816.48±235.82	643.27±175.89	106 (64.24)
t/χ^2	0.946	3.260	9.968	16.059
P	0.345	0.001	<0.001	<0.001

Note: SII: Systemic immune-inflammation index.

Table 3. Comparison of PNI between the two groups before and after treatment

	Before treatment	1 month after treatment	3 months after treatment	PNI≥45 points
Combined group (n=174)	41.26±3.55	46.04±3.88	48.08±4.21	141 (82.94)
Control group (n=165)	41.14±3.61	45.20±3.74	46.09±4.30	115 (69.70)
t/χ^2	0.323	2.021	4.298	8.150
P	0.747	0.044	<0.001	0.004

Note: PNI: Prognostic nutritional index.

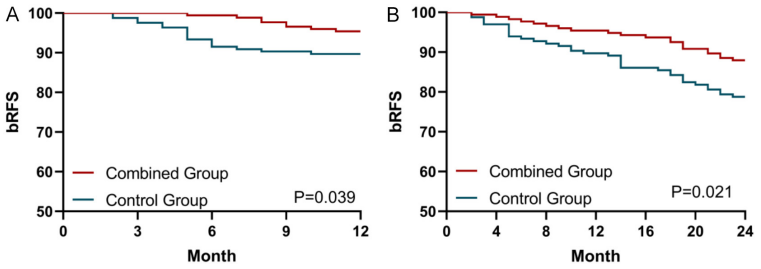

Figure 2. Comparison of 1-year (A) and 2-year (B) bRFS between the two groups. Note: Biochemical recurrence-free survival (bRFS).

to decrease the infiltration of myeloid-derived suppressor cells and regulatory T cells, while potentially enhancing cytotoxic T cell activity. The improvement in PNI may therefore be associated with a more favorable systemic inflammatory and immune status, coupled with reduced cancer-related catabolic demand following effective tumor debulking. The intrinsic correlation between SII/PNI and bRFS may thus be mediated by alterations in host immune-nutritional status. Lower post-treatment SII and higher PNI likely indicate a more favorable host immune-nutritional milieu, which could be less conducive to the progression of minimal residual disease and may contribute to delayed biochemical recurrence.

SII decline was greater in the combination group at 1 and 3 months, with more patients achieving ≥30% reduction; conversely, PNI increase was more pronounced, and more patients reached PNI≥45. Population-based data from Yao et al. [15] showed that elevated SII is associated with increased prostate cancer risk and elevated PSA levels, corroborating the role of SII as a marker of tumor-related inflammatory status. Furthermore, SII <1168.18 has been reported to correlate with PSA levels [16], suggesting its potential utility in reflecting tumor burden. Elevated SII has been linked to platelet- and neutrophil-mediated immunosuppression and expansion of myeloid-derived suppressor cells, which may contribute to tumor progression and metastasis [17, 18]. The reduction in SII observed in the combination group may therefore be associated with decreased tumor burden and attenuation of systemic inflammation.

PNI, which integrates serum albumin and lymphocyte count, reflects the interaction between nutritional status and immune function. A low PNI is generally associated with cancer-related cachexia and immune exhaustion [19, 20]. A meta-analysis by Tobing et al. [21] identified low PNI as an independent predictor of shorter overall and progression-free survival in multiple malignancies, consistent with the prognostic significance of PNI improvement observed in this study. Literature indicates a PNI cut-off of approximately 44.925 for predicting bone metastasis [22], which is comparable to the threshold (PNI≥45) used in this study. PNI

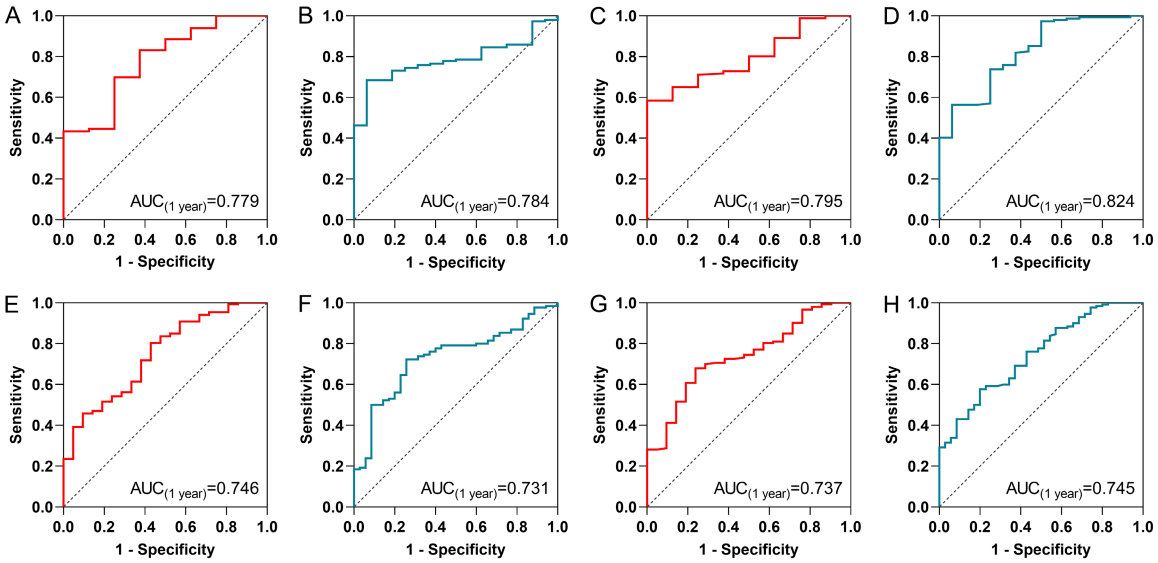

Figure 3. Predictive value of post-treatment SII and PNI for 1- and 2-year bRFS analyzed by ROC curve analysis. A. SII at 3 months for predicting 1-year bRFS in the combination group: AUC=0.779 (95% CI: 0.701-0.857). B. SII at 3 months for predicting 1-year bRFS in the control group: AUC=0.784 (95% CI: 0.706-0.862). C. PNI at 3 months for predicting 1-year bRFS in the combination group: AUC=0.795 (95% CI: 0.720-0.870). D. PNI at 3 months for predicting 1-year bRFS in the control group: AUC=0.824 (95% CI: 0.752-0.896). E. SII at 3 months for predicting 2-year bRFS in the combination group: AUC=0.746 (95% CI: 0.663-0.829). F. SII at 3 months for predicting 2-year bRFS in the control group: AUC=0.731 (95% CI: 0.648-0.814). G. PNI at 3 months for predicting 2-year bRFS in the combination group: AUC=0.737 (95% CI: 0.652-0.822). H. PNI at 3 months for predicting 2-year bRFS in the control group: AUC=0.745 (95% CI: 0.661-0.829). Note: Systemic immune-inflammation index (SII); Prognostic nutritional index (PNI); Biochemical recurrence-free survival (bRFS).

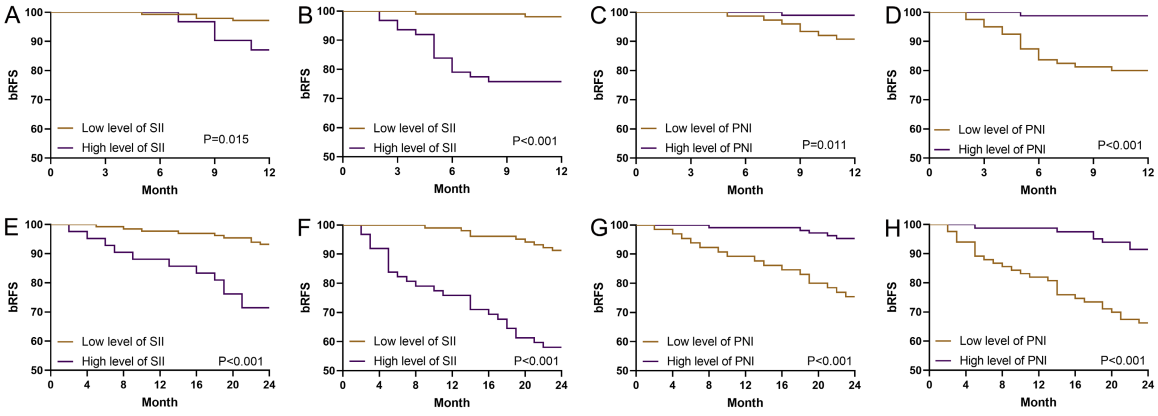

Figure 4. Analysis of 1- and 2-year bRFS stratified by high and low SII and PNI levels at 3 months. A. 1-year bRFS in high- vs. low-SII subgroups in the combination group; B. 1-year bRFS in high- vs. low-SII subgroups in the control group; C. 1-year bRFS in high- vs. low-PNI subgroups in the combination group; D. 1-year bRFS in high- vs. low- PNI subgroups in the combination group; E. 2-year bRFS in high- vs. low-SII subgroups in the combination group; F. 2-year bRFS in high- vs. low-SII subgroups in the control group; G. 2-year bRFS in high- vs. low-PNI subgroups in the combination group; H. 2-year bRFS in high- vs. low-PNI subgroups in the combination group. Note: Systemic immune-inflammation index (SII); Prognostic nutritional index (PNI); Biochemical recurrence-free survival (bRFS).

improvement may result from diminished metabolic demand after PAE and restored immunosurveillance by neoadjuvant novel hormonal therapy. Additionally, Li et al. [23] reported that PNI has prognostic value comparable to conventional staging systems in prostate cancer, supporting the potential utility of SII and PNI as early, accessible prognostic biomarkers.

The observed prognostic benefit may stem from the comprehensive effects of the combination regimen. The 1- and 2-year bRFS rates favored the combination group, and Kaplan-Meier curves demonstrated increasing separation over time. Potential explanations include tumor downstaging, which may reduce the risk of micrometastatic disease, and improvements in systemic inflammatory and nutritional status, which may delay biochemical relapse. Time-dependent ROC revealed good predictive performance of SII and PNI at 3 months for both 1- and 2-year bRFS. K-M analyses stratified by ROC cut-offs confirmed significantly lower bRFS in high-SII patients and higher bRFS in high-PNI patients, underscoring the universal prognostic relevance of these indices.

The clinical value of this study lies in its minimal invasiveness and high therapeutic efficacy. As an interventional procedure, PAE is well tolerated even in elderly patients with comorbidities, enhancing surgical feasibility and quality of life. Compared with neoadjuvant novel hormonal therapy alone, the addition of PAE may enhance tumor control and provide a complementary neoadjuvant option for patients with locally advanced disease. In addition, SII and PNI are low-cost and readily accessible biomarkers that can be repeatedly measured, allowing dynamic monitoring and risk stratification. This may facilitate personalized management (e.g. adding immune-checkpoint inhibitors when SII fails to decline). The safety profile of PAE observed in this study is consistent with previous reports in both benign prostatic hyperplasia and prostate cancer. Although improved bRFS may suggest a potential benefit in delaying disease progression, its impact on long-term outcomes, including distant metastasis and overall survival, requires further investigation.

Limitations in this study should also be acknowledged. First, the retrospective design may introduce selection bias. Although baseline characteristics were all balanced between groups, potential unmeasured confounders, such as treatment adherence, could not be fully controlled. Second, the sample size was relatively modest, and the follow-up duration was relatively short, precluding assessment of long-term outcomes, including metastasis and overall survival. Third, the relatively high proportion of patients with baseline bone metastasis may limit the generalizability of these findings to non-metastatic high-risk populations.

Conclusion

Neoadjuvant novel hormonal therapy combined with PAE significantly improves PSA response, increases the rate of conversion to radical surgery, and prolongs bRFS in patients with high-risk prostate cancer. These therapeutic benefits are closely associated with improvements in systemic inflammatory and nutritional status.

Disclosure of conflict of interest

None.

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