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Original Article

Can systemic immune-inflammation index and hematologic parameters aid in decision-making for active surveillance or curative treatment in low-risk prostate cancer?

Burhan Baylan [a, *], Kemal Ulusoy [a], Berk Ekenci [b], Ibrahim Guven Kartal [c]

[a] Afyonkarahisar Health Sciences University Department of Urology, Afyonkarahisar, Turkiye
[b] Department of Urology, Health Sciences University Diskapi Training and Research Hospital, Ankara, Turkiye
[c] Kutahya Health Sciences University Evliya Çelebi Training and Research Hospital Department of Urology, Kutahya, Turkiye

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ABSTRACT

Introduction: Pathologic Gleason Score (GS) upgrading is common in patients with low-risk localized prostate cancer (PCa) who are followed by active surveillance (AS) or undergo radical prostatectomy (RP). This fact raises concerns about inadequate treatment, especially in AS patients. We aimed to analyze the association of preoperative neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), and systemic immune-inflammation (SII) index with GS upgrading.

Materials and methods: This study was approved by the Ethical Review Committee of Afyonkarahisar Health Sciences University. Data of the patients who underwent RP for PCa at three different centers between 2018 and 2023 were retrospectively analyzed. The patients were divided into 2 groups based on GR upgrading status as "upgrading" and "non-upgrading". Among the patients who underwent RP, 77 patients who fully met the criteria for AS were identified. The patients eligible for AS were divided into "non-upgrading" and "upgrading" groups. These groups were compared regarding NLR, PLR, and SII index values.

Results: Overall, data from 250 patients were reviewed. Among these, 147 had GS upgrading, while 103 had no upgrading. Seventy-seven patients were eligible for AS. Among these patients, 30 had upgrading, while 47 were in the "non-upgrading" group. Our analysis revealed that an NLR of 1.85 and above was associated with a 2.238-fold increase in the risk of GS upgrading ($p = 0.009$). Also, a PLR of 115.7 and above was affiliated with a 2.992-fold increase in the GS upgrading risk ($p < 0.001$). The analysis regarding patients who underwent RP but were eligible for AS revealed that an NLR of $\geq$1.68 was associated with a 3.25-fold risk increase in GS upgrading. On the other hand, a PLR$\geq$134.5 and an SII index$\geq$630.7 were affiliated with a 12.303-fold and 6.562-fold increase in the risk of upgrading ($p = 0.019$, $p = 0.018$).

Conclusion: The decision of AS should be carefully reappraised, and treatment methods such as RP or radiotherapy should be considered in patients with high NLR, PLR, or SII index values.

1. Introduction

For patients with localized prostate cancer (PCa), different management options can be considered, including watchful waiting, active surveillance (AS), or definitive treatment options such as RP, external beam radiation therapy, or brachytherapy.[1] The management plan should be discussed with a multidisciplinary team. The final plan should depend on the patient's risk stratification based on clinical T-stage, Gleason score (GS), serum prostate-specific antigen (PSA) level, treatment-related side effects, patient comorbidities, and the patient's preference[2–5].

Accurate identification of GS plays a crucial role in disease management and prognosis. The GS upgrading is a well-known phenomenon encountered in some patients with low-risk PCa

* Corresponding author. Zafer Sağlık Külliyesi Dörtyol Mah, 2078 Sokak, No: 3, A Blok, Pk. 03030, Afyonkarahisar, Turkiye.
E-mail addresses: baylanburhan@gmail.com (B. Baylan), kemalulusoymd@gmail.com (K. Ulusoy), ekenciberk@gmail.com (B. Ekenci), igk84@hotmail.com (I.G. Kartal).

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who were initially managed by AS and subsequently underwent RP. This phenomenon raises concern about inadequate treatment in AS patients.[2–5]

The GS upgrading was shown to be significantly associated with biochemical recurrence, distant metastasis, and PCa-related mortality.[6,7] Fortunately, some researchers reported that parameters such as PSA, prostate volume, number of biopsy cores, and age might predict upgrading.[6–10]

It was reported that inflammation might play a role in the etiopathogenesis of PCa, as in many cancer types.[11,12] According to the previously published data, an increased neutrophil-to-lymphocyte ratio (NLR) was associated with PCa.[13,14] However, this parameter failed to differentiate prostatitis patients from PCa patients. In line with this finding, low lymphocyte count was reported as an unfavorable prognostic marker for PCa.[15] On the other hand, increased platelet counts were associated with poor prognosis in patients with PCa.[16,17]

The systemic immune-inflammation (SII) index combines these parameters and is calculated by multiplying the absolute neutrophil and platelet counts and dividing by the absolute lymphocyte count.[18,19] The NLR was proposed as an indicator of cancer-related inflammation and a marker of unfavorable prognosis in various cancer types. In metastatic PCa patients, high NLR was associated with aggression of the disease. As such, preoperative NLR was shown to be an independent prognostic factor for overall and cancer-specific survival after RP, and a high NLR was associated with a high GS.[15,20]

This study evaluated the preoperative NLR, PLR, and SII index values in RP patients to analyze their success in predicting GS upgrading. We also analyzed whether these parameters were predictive for GS upgrading in patient groups that fully met the criteria for AS.

2. Materials and Methods

This study was approved by the Ethical Review Committee of Afyonkarahisar Health Sciences University (2022/13). All centers involved in the study agreed with the study protocol. The study was conducted following the principles reported in the Declaration of Helsinki. Data from 250 patients who underwent radical prostatectomy at three centers -Afyonkarahisar Health Sciences University, Health Sciences University Diskapi Training and Research Hospital, and Kutahya Health Sciences University Training and Research Hospital-between 2018 and 2023 were retrospectively reviewed. Patients with acute or chronic prostatitis diagnosed clinically or by biopsy pathologic evaluation were excluded from the study. Patients with incomplete data, including prostate biopsy and RP specimen pathology GS were excluded. Patients with a history of clinical or histopathologically-proven prostatitis were also omitted. The remaining patients were divided into 2 groups: “GS upgrading” and “GS non-upgrading”. Clinical data, including age, serum PSA level, prostate biopsy GS, RP specimen GS, clinical T-stage, and presence or absence of surgical margin positivity, were retrieved from the electronic patient folders. Also, preoperative hematologic parameters, including NLR, PLR, and SII index values, were calculated based on preoperative complete blood counts. After applying the inclusion and exclusion criteria, the patients who were eligible for AS were also identified. These patients were divided into “non-upgrading” and “upgrading” groups. The groups were compared regarding NLR, PLR, and SII index values.

3. Statistical analysis

Data analysis was performed using IBM SPSS Statistics *ver.* 25.0 software (IBM Corporation, Armonk, NY, US). Categorical data were expressed as numbers (n) and percentage (%) while quantitative data were given as mean ± SD and median (25th-75th) percentiles. Univariate logistic regression analyses were applied for determining the associations between demographic, clinical and biochemical variables with the main outcome variable (i.e., non-upgrading *vs* upgrading). Odds ratios and 95 % confidence interval for each potential predictor was also calculated. The optimal thresholds for laboratory (i.e., NLR, PLR and SII index) measures in order to determine on being upgrading was evaluated by ROC analyses as giving the maximum sum of sensitivity and specificity for the significant test. The sensitivity, specificity, positive, and negative predictive values, and accuracy levels for each significant laboratory measurement were also obtained. Finally, the multiple logistic regression analyses via Backward LR procedure were performed to determine the best predictors which effect on being upgrading. Any variable whose univariable test had a p value < 0.10 was accepted as a candidate for the multivariable model along with all variables of known clinical importance. Odds ratios, 95 % confidence intervals and Wald statistics for each independent variable were also calculated. A p value less than 0.05 was considered statistically significant.

4. Results

Overall, data from 250 patients were reviewed. Among these, 147 had GS upgrading, while 103 had no upgrading. Seventy-seven patients were eligible for AS. Among these patients, 30 had upgrading, while 47 were in the “non-upgrading” group.

Table 1 shows the univariate logistic regression analysis results for potential predictors of upgrading the entire cohort.

This analysis revealed that the risk of upgrading decreased significantly with increasing age ($p < 0.001$). Similarly, there was a statistically significant and inverse association between the biopsy Gleason score and upgrading ($p < 0.001$). Hematologic parameters such as NLR, PLR, and SII index did not significantly impact upgrading ($p > 0.05$). As such, there was no statistically significant association between serum PSA level, clinical stage, risk status, eligibility for AS, organ confinement, surgical margin negativity, and upgrading ($p > 0.05$).

Table 2 shows the results of receiver operating curve (ROC) analysis for NLR, PLR, and SII index measurements in differentiating the non-upgrading group from the upgrading group in the entire cohort. According to these results, NLR measurements could not differentiate the non-upgrading patients from the upgrading patients ($p = 0.055$) (Fig. 1). However, considering these results, cut-off levels were determined. For NLR, the value at which the sum of the sensitivity and specificity reached the maximum was considered the optimal cut-off. In cases with NLR<1.85, the risk of upgrading was 2.047 times higher than in those with NLR $\geq$1.85 ($p = 0.01$).

According to the analysis regarding PLR values, PLR could not differentiate non-upgrading cases from upgrading cases ($p = 0.104$) (Fig. 1). Again, a cut-off level was calculated by considering the univariate logistic regression and ROC analyses. This analysis revealed that RP patients with a PLR$\geq$115.7 had a of upgrading increased 1.615-fold in PCa patients with a PLR$\geq$115.7, compared to patients with a PLR<115.7, the difference was not statistically significant ($p = 0.064$).

Likewise, the SII index could not differentiate the non-upgrading from the upgrading group ($p = 0.116$) (Fig. 1). However, a cut-off value was calculated considering the univariate logistic regression and the ROC analysis findings. For the SII index, the value at which the sum of the sensitivity and specificity reached the maximum was considered the optimal cut-off. This analysis revealed that patients with an SII index$\geq$429 had a 1.792-fold

Table 1
The comparisons between non-upgrading and upgrading cases – the results of univarite logistic regression analyses

	Non-upgrading (n=103)	Upgrading (n=147)	OR (95%CI)	p-value
Age (years) *	67.2±6.2	63.8±7.1	0.929 (0.894-0.967)	**<0.001**
PSA *	13.0±10.2	12.8±13.9	0.998 (0.979-1.019)	0.877
Biopsy Gleason **	ISUP 2 (ISUP 1 - ISUP 2)	ISUP 1 (ISUP 1 - ISUP 1)	0.362 (0.238-0.551)	**<0.001**
Clinical stage **	T_{2a} (T_{1c}-T_{2b})	T_{2a} (T_{1c}-T_{2b})	1.016 (0.807-1.279)	0.893
Status of risk				
Mild	37 (35.9%)	55 (45.4%)	1.000	Reference
Moderate	35 (34.0%)	36 (29.8%)	0.692 (0.371-1.292)	0.248
Severe	31 (30.1%)	30 (24.8%)	0.651 (0.339-1.250)	0.197
Eligible for active monitoring	30 (29.1%)	47 (34.8%)	1.300 (0.747-2.260)	0.353
Organ boundaries	4 (3.9%)	3 (2.0%)	0.516 (0.113-2.354)	0.393
Extra-prostatic **extension**	31 (30.1%)	28 (19.0%)	0.546 (0.303-0.985)	**0.044**
Seminal vesicle invasion	15 (14.6%)	20 (13.6%)	0.924 (0.449-1.903)	0.830
Surgical boundaries	20 (19.4%)	28 (20.3%)	1.056 (0.557-2.005)	0.867
Neutrophil/lymphocyte (NLR) *	2.34±1.01	2.83±2.50	1.204 (0.970-1.494)	0.092
Platelet/ lymphocyte (PLR) *	119.6±45.9	134.3±79.4	1.004 (0.999-1.010)	0.099
SII index (NLR X PLR) *	549.4±257.7	655.9±522.8	1.001 (1.000-1.002)	0.070

Data were shown as * mean ± SD or ** median (25th – 75th) percentiles; where appropriate. OR: Odds ratio, CI: Confidence interval.

Table 2
The results of ROC analyses for biochemical measures in order to determine on being upgrading.

	NLR	PLR	SII index
Area under the curve	0.571	0.560	0.558
95 % Confidence interval	0.498–0.644	0.488–0.633	0.486–0.631
p-value †	0.055	0.104	0.116
Optimal cut-off point	≥1.85	≥115.7	≥429.0
Sensitivity	74.8 %	58.5 %	71.4 %
Specificity	40.8 %	53.4 %	41.7 %
Positive predictive value	64.3 %	64.2 %	63.6 %
Negative predictive value	53.2 %	47.4 %	50.6 %
Accuracy	60.8 %	56.4 %	59.2 %
Odds ratio	2.047	1.615	1.792
95 % Confidence interval	1.191–3.518	0.973–2.683	1.054–3.045
p-value ‡	**0.010**	0.064	**0.031**

†ROC analysis, ‡ Univariate logistic regression analyis.

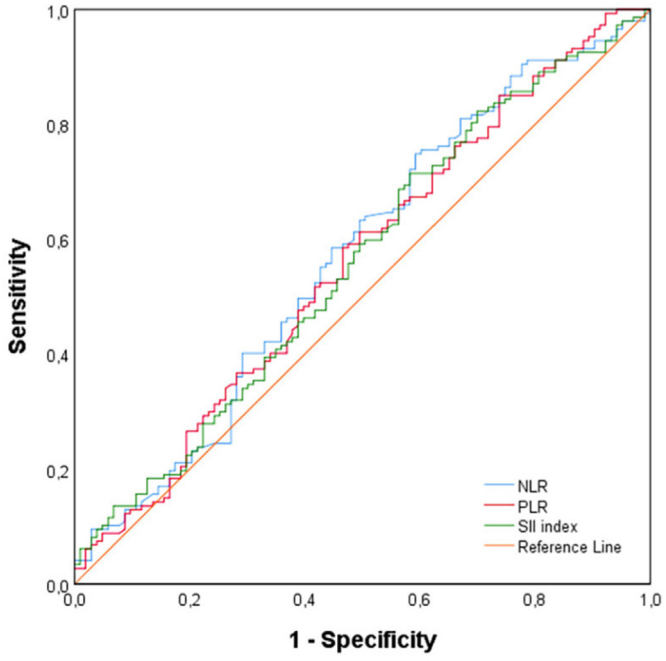

Fig. 1.

higher risk of upgrading than those with an SII index<429 (p = 0.031).

The most significant parameters differentiating the non-upgrading group from the upgrading in the entire cohort are displayed in Table 3.

All variables with a p < 0.10 in univariate statistical analysis were included in the regression model for further analysis. The backward logistic regression analysis revealed that the strongest determinants of upgrading were biopsy GS, age, and PLR, respectively. Independently from other factors, the risk of upgrading decreased significantly as the biopsy GS (p < 0.001) and age increased (p < 0.001, p < 0.001). After adjustment for other factors, it was determined that a PLR of 115.7 or above was associated with a 2.992-fold increase in the risk of upgrading (p < 0.001).

The results of the analysis regarding the efficacy of individual parameters in differentiating the non-upgrading group from the upgrading after adjustment for the confounding factors are

Table 3
Determining the best predictor(s) which affected on being upgrading – the results of multiple logistic regression analysis via backward LR procedure.

	OR (95 % CI)	Wald	p-value
Model 1			
Age	0.912 (0.872–0.954)	16.035	<**0.001**
Biopsy Gleason	0.282 (0.170–0.467)	24.128	<**0.001**
Extra-prostatic extension	0.932 (0.449–1.936)	0.035	0.851
NLR≥1.85	1.127 (0.486–2.613)	0.077	0.781
PLR≥115.7	2.274 (1.104–4.686)	4.964	**0.026**
SII index≥429.0	1.550 (0.642–3.743)	0.949	0.330
Model 2			
Age	0.912 (0.871–0.954)	16.076	<**0.001**
Biopsy Gleason	0.279 (0.171–0.455)	26.118	<**0.001**
NLR≥1.85	1.122 (0.484–2.598)	0.072	0.789
PLR≥115.7	2.284 (1.110–4.698)	5.039	**0.025**
SII index≥429.0	1.543 (0.640–3.721)	0.933	0.334
Model 3			
Age	0.911 (0.871–0.953)	16.533	<**0.001**
Biopsy Gleason	0.277 (0.170–0.451)	26.679	<**0.001**
PLR≥115.7	2.321 (1.140–4.728)	5.386	**0.020**
SII index≥429.0	1.654 (0.806–3.392)	1.884	0.170
Model 4			
Age	0.912 (0.873–0.954)	16.218	<**0.001**
Biopsy Gleason	0.282 (0.175–0.457)	26.605	<**0.001**
PLR≥115.7	2.992 (1.621–5.520)	12.295	<**0.001**

OR: Odds ratio, CI: Confidence interval.

displayed in Table 4.

All variables with p < 0.10 in univariate analysis were included in a regression model. After the adjustment for all possible confounding factors, it was determined that an NLR of 1.85 and above were associated with a 2.238-fold increase in the risk of upgrading (p = 0.009). This analysis also showed that biopsy GS, the presence of extraprostatic invasion, and a PLR of 115.7 and above were affiliated with a 2.992-fold increase in the risk of upgrading, independent of age (p < 0.001). Finally, after adjustment for all other possible confounding factors, an SII index of 429 was associated with a 2.618-fold increase in the risk of upgrading (p = 0.002).

The results of the univariate logistic regression analysis for all factors potentially affecting upgrading in patients eligible for AS are shown in Table 5. As per these findings, the upgrading risk decreased significantly with age (p = 0.008). Also, as the PLR level increased, the risk of upgrading increased significantly (p = 0.024). Similarly, as the SII index increased, the risk of upgrading increased significantly (p = 0.042). On the other hand, there was no significant association between serum PSA level, clinical stage, extraprostatic extension, surgical margin positivity, NLR, and upgrading (p > 0.05).

The results of the ROC analysis performed to investigate the efficacies of NLR, PLR, and SII index in differentiating non-upgrading cases from upgrading in patients eligible for AS are exhibited in Table 6. This analysis revealed that NLR could effectively differentiate non-upgrading cases from upgrading in the group of patients eligible for AS (AUC = 0.638, 95 % CI: 0.511–0.765, p = 0.042) (Fig. 2). For the NLR, the value at which the sum of the sensitivity and specificity reached the maximum level was considered the optimal cut-off. The risk of upgrading was 3.25-fold (95 % CI: 1.132–9.330) higher in the cases with an NLR≥1.68 than those with an NLR<1.68 (p = 0.028).

In addition, our analysis revealed that PLR could effectively differentiate non-upgrading cases from upgrading in patients eligible for AS (p = 0.056) (Fig. 2). Similar to NLR, the value at which the sum of the sensitivity and specificity reached the maximum level was considered the optimal cut-off for PLR. The optimal cut-off was calculated as 134.5; patients with a PLR of ≥134.5 had a 12.303-fold higher risk of upgrading than those with a PLR<134.5 (p = 0.019).

On the other hand, a similar analysis regarding SII index revealed that this parameter could not differentiate non-upgrading cases from upgrading in patients (p = 0.181) (Fig. 2). However, a cut-off value was calculated considering the univariate logistic regression and the ROC analysis results. The value at which the sum of the sensitivity and specificity reached the maximum was considered the optimal cut-off. This analysis revealed that patients with an SII index≥630.7 had a 6.562-fold higher risk of upgrading than those with levels below 630.7 (p = 0.018).

The most significant parameters differentiating the non-upgrading group from the upgrading in patients eligible for AS are displayed in Table 7.

All variables revealing a p-value lower than 0.10 in the univariate analysis were included in a regression model. The backward logistic regression analysis revealed that the strongest determinants differentiating the non-upgrading group from the upgrading group were age and PLR, respectively. Independent of other factors, the risk of upgrading decreased statistically significantly with age (p = 0.009). When adjusted for other variables, a PLR of 134.5 and above was associated with a 12.905-fold increase in the risk of upgrading (p < 0.018).

Table 4
The affects of biochemical measurements in order to determine on being upgrading after adjutment for all possible confounding factor – the results of multiple logistic regression analyses via enter method (alternative table).

	OR (95 % CI)	Wald	p-value
Model 1			
Age	0.924 (0.885–0.965)	12.846	**<0.001**
Biopsy Gleason	0.340 (0.213–0.543)	20.393	**<0.001**
Extra-prostatic extension	0.898 (0.439–1.838)	0.087	0.769
NLR≥1.85	2.238 (1.220–4.106)	6.768	**0.009**
Model 2			
Age	0.912 (0.873–0.954)	16.198	**<0.001**
Biopsy Gleason	0.283 (0.172–0.465)	24.917	**<0.001**
Extra-prostatic extension	0.989 (0.480–2.037)	<0.001	0.975
PLR≥115.7	2.992 (1.621–5.521)	12.294	**<0.001**
Model 3			
Age	0.917 (0.877–0.958)	14.958	**<0.001**
Biopsy Gleason	0.312 (0.193–0.504)	22.646	**<0.001**
Extra-prostatic extension	0.892 (0.435–1.829)	0.097	0.756
SII index≥429.0	2.618 (1.412–4.854)	9.341	**0.002**

OR: Odds ratio, CI: Confidence interval.

5. Discussion

The GS on preoperative prostate biopsy remains one of the most critical clinical decision–maker parameters in PCa patients. In some patients, upgrading of the GS can be detected on the histopathological examination of the RP specimen. This phenomenon raises concerns about inadequate treatment, especially in patients classified as low-risk and whose primary management plan is AS.

Currently, PCa patients are classified based on risk according to the D'Amico criteria, which involves the patients' clinical stage, GS, and serum PSA level. *Active surveillance* is a strategy that can prevent RP-related side effects, particularly for men with low-risk PCa. It was reported that upgrading was detected in approximately 30 % of the patients who underwent RP.[21]

Despite several clinical and biochemical parameters recently proposed as a tool to select the best candidates for AS, the risk of misclassification or missing a high-risk cancer case remains a clinical problem. Therefore, the researchers worked on some alternative and adjunct parameters for selecting the most suitable patients for AS.[22–25]

Ferro et al reported that high NLR and PLR values were associated with upgrading in low-risk PCa patients.[26] In line with this finding, Van Soest et al showed that a high NLR value predicted upgrading and biochemical recurrence in patients with low-risk PCa.[27]

In a retrospective analysis of 210 low-risk PCa patients who underwent RP, Gokce et al concluded that NLR was not a predictive factor for upstaging in low-risk PCa patients; however, it might indicate upgrading and biochemical recurrence.[28]

In contrast, Kwon et al, who retrospectively analyzed the data of 217 low-risk PCa patients eligible for AS, reported that NLR was not associated with upgrading, upstaging or biochemical recurrence.[29]

Our study found that NLR and PLR values were significant predictors of upgrading in low-risk PCa patients eligible for AS. However, SII index did not emerge as a significant indicator of upgrading in this patient group.

Ozsoy et al stated that PCa patients with a pre-RP NLR value of ≥3 had a significantly higher risk of upgrading than patients with an NLR value below 3.[30] These authors noted that preoperative NLR measurements might be helpful in selected patients while making AS protocols. Our analysis regarding the entire cohort (i.e., all patients undergoing RP) revealed that NLR, PLR, and SII index did not have a significant impact on upgrading (p > 0.05). However, the univariate logistic regression and the ROC analyses showed that an NLR value of ≥1.85 was associated with an approximately 2-fold increase in the risk of upgrading. As such, a SII index of ≥429 was

Table 5
The comparisons between non-upgrading and upgrading groups within the cases who were eligable for active monitoring – the results of univarite logistic regression analyses.

	Non-upgrading (n = 30)	Upgrading (n = 47)	OR (95%CI)	p-value
Age (years) *	68.2 ± 6.0	64.3 ± 5.6	0.884 (0.808–0.968)	**0.008**
PSA *	6.0 ± 1.7	6.6 ± 2.1	1.095 (0.863–1.389)	0.455
Biopsy Gleason **	ISUP 1 (ISUP 1 - ISUP 1)	ISUP 1 (ISUP 1 - ISUP 1)	N/A	N/A
Clinical stage **	T_{1c} (T_{1c}-T_{1c})	T_{1c} (T_{1c}-T_{2a})	0.820 (0.339–1.987)	0.661
Organ boundaries	0 (0.0 %)	1 (2.1 %)	N/A	N/A
Extra-prostatic **extension**	3 (10.0 %)	5 (10.6 %)	1.071 (0.236–4.854)	0.929
Seminal vesicle invasion	0 (0.0 %)	3 (6.4 %)	N/A	N/A
Surgical boundaries	3 (10.0 %)	9 (20.5 %)	2.314 (0.571–9.383)	0.240
Neutrophil/lymphocyte (NLR) *	2.07 ± 0.71	2.91 ± 2.82	1.702 (0.954–3.040)	0.072
Platelet/ lymphocyte (PLR) *	100.2 ± 22.6	123.5 ± 49.4	1.021 (1.003–1.039)	**0.024**
SII index (NLR X PLR) *	447.5 ± 112.7	632.8 ± 563.5	1.003 (1.001–1.006)	**0.042**

Data were shown as * mean ± SD or ** median (25th – 75th) percentiles; where appropriate. OR: Odds ratio, CI: Confidence interval. N/A: Not available.

Table 6
The results of ROC analyses for biochemical measures in order to determine upgrading within the cases who were eligable for active monitoring.

	NLR	PLR	SII index
Area under the curve	0.638	0.630	0.591
95 % Confidence interval	0.511–0.765	0.506–0.753	0.465–0.717
p-value †	**0.042**	0.056	0.181
Optimal cut-off point	≥1.68	≥134.5	≥630.7
Sensitivity	83.0 %	29.8 %	31.9 %
Specificity	40.0 %	96.7 %	93.3 %
Positive predictive value	68.4 %	93.3 %	88.2 %
Negative predictive value	60.0 %	46.8 %	46.7 %
Accuracy	66.2 %	55.9 %	55.9 %
Odds ratio	3.250	12.303	6.562
95 % Confidence interval	1.132–9.330	1.523–99.389	1.379–31.234
p-value ‡	**0.028**	**0.019**	**0.018**

†ROC analysis, ‡ Univariate logistic regression analyis.

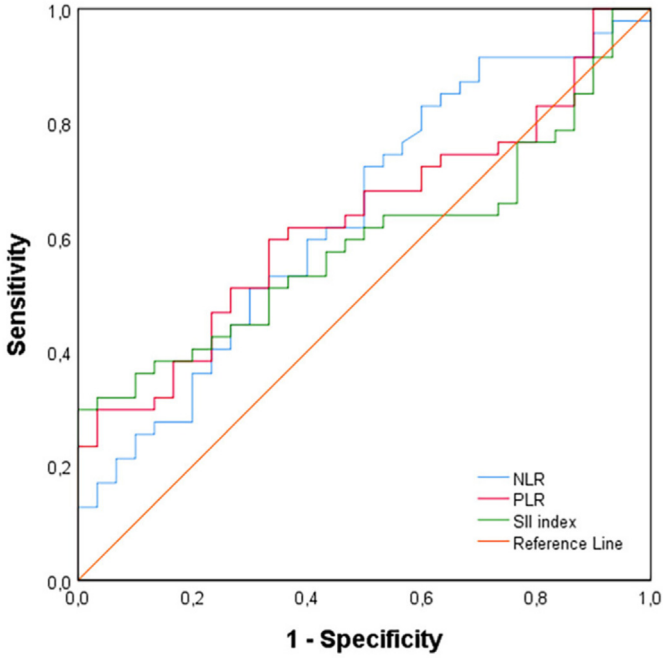

Fig. 2.

associated with an approximately 1.8-fold increase in the risk of upgrading. On the other hand, although a PLR value of ≥115.7 led to a 1.6-fold increase in the upgrading risk, this increase was statistically insignificant.

Table 7
Determining the best predictor(s) which affected on being upgrading within the cases who were eligable for active monitoring – the results of multiple logistic regression analysis via backward LR procedure.

	OR (95 % CI)	Wald	p-value
Model 1			
Age	0.887 (0.804–0.978)	5.796	**0.016**
NLR≥1.68	2.092 (0.636–6.881)	1.477	0.224
PLR≥134.5	7.888 (0.855–72.774)	3.319	0.068
SII index≥630.7	1.854 (0.315–10.905)	0.467	0.495
Model 2			
Age	0.880 (0.799–0.968)	6.89	**0.009**
NLR≥1.68	2.327 (0.729–7.435)	2.033	0.154
PLR≥134.5	9.811 (1.144–84.132)	4.338	**0.037**
Model 3			
Age	0.882 (0.802–0.969)	6.85	**0.009**
PLR≥134.5	12.905 (1.558–106.918)	5.62	**0.018**

OR: Odds ratio, CI: Confidence interval.

Our study's retrospective design and relatively small sample size constitute its primary limitations. Therefore, our findings need to be confirmed by prospective studies conducted with more extensive patient series.

6. Conclusion

Despite the abovementioned limitations, we conclude that high NLR and PLR values can be associated with GS upgrading in patients with low-risk prostate cancer who are planned to be recruited to AS programs. Curative treatment options such as RP or radiotherapy may be preferred in patients with high NLR and PLR values.

Declaration of competing interest

The authors declare that they have no affiliation with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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