

Low Prognostic Nutritional Index Predicts Poor Clinical Outcomes in Patients with Stage IIIB Non-small-cell Lung Carcinoma Undergoing Chemoradiotherapy

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Purpose: To investigate the prognostic utility of the prognostic nutritional index (PNI) in stage IIIB non-small-cell lung carcinoma (NSCLC) patients undergoing concurrent chemoradiotherapy (CRT).

Methods: A total of 358 stage IIIB NSCLC patients who received a total dose of 60–66 Gy (2 Gy/fraction) radiotherapy and ≥ 1 cycle(s) of platinum-based chemotherapy were analyzed. The receiver operating curve analysis was utilized to identify the optimal PNI cut-off value demonstrating a significant connection with the overall survival (OS), locoregional progression-free survival (LRPFS), and progression-free survival (PFS).

Results: At a median follow-up time of 22.5 months (range: 2.4–123.5), 30.2% and 14% of the patients were still alive and free of disease progression, respectively. The median OS, LRPFS, and PFS were 25.2 [95% confidence interval (CI): 36.3–46.6 months], 15.4 (95% CI: 26.6–35.3 months), and 10.7 (95% CI: 36.8–69.9 months), individually, for the whole study populace. The ROC analysis revealed an optimum rounded cut-off that associated meaningfully with each of the OS [area under the curve (AUC): 84.1%; sensitivity: 75.9%; 72.4% specificity], LRPFS (AUC: 92.4%; sensitivity: 87.9%; 85.1% specificity), and PFS (AUC: 80.1%; sensitivity: 73.7%; 71.6% specificity) at a value of 40.5. Comparative analyses revealed that the patients presenting with $PNI \leq 40.5$ had significantly inferior OS (16.8 vs 36.7; $P < 0.001$), LRPFS (11.5 vs 19.5; $P < 0.001$), and PFS (8.6 vs 13.6; $P < 0.001$) outcomes compared to patients with $PNI > 40.5$. In univariate analyses, lower T-stage (1–2 vs 3–4; $P < 0.001$), lower N-stage (N2 vs N3; $P < 0.001$), anemia status (absent vs present; $P < 0.001$), weight loss status ($< 5\%$ vs $\geq 5\%$; $P < 0.001$), and PNI group (≤ 40.5 vs > 40.5 ; $P < 0.001$) were the factors found to be associated with OS, LRPFS and PFS results. The results of multivariate analysis exhibited that the PNI was independently associated with each of the OS ($P < 0.001$), LRPFS ($P < 0.001$), and PFS ($P < 0.001$) outcomes.

Conclusion: The pretreatment PNI appears to be a robust novel prognostic factor that stratifies patients with stage IIIB NSCLC into two significantly distinct survival groups after CRT.

Keywords: prognostic nutritional index, non-small-cell lung carcinoma, prognosis, chemoradiotherapy, survival results

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Introduction

The standard of care in patients with unresectable stage III non-small-cell lung carcinoma (NSCLC) is chemoradiotherapy (CRT), which offers a 5-year overall survival (OS) rate of only 16%.^{1,2} Despite the fact that well-established

conventional prognostic tools (ie, tumor-node-metastasis [TNM], histological subtype, and genetic biomarkers) may stratify patients into significantly distinct outcome groups, unexpected recurrences or CRT resistance can still occur, which are common obstacles for the treatment approach and confer a relatively worse prognosis contrasted to patients presenting with indistinguishable TNM stages.^{3,4} Moreover, the high cost and inconvenience of reliable genetic biomarker detection restrict the use of customized treatments based on such genetic biomarkers, especially in countries with limited incomes.⁴ These limitations may cause difficulties in predicting treatment responses, which can lead to insufficient disease management (eg, using less aggressive forms of therapy) or overtreatment, resulting in either treatment failure or treatment-related toxicity, respectively.⁵ Therefore, novel practical prognostic tools with a lower cost are required to anticipate host treatment responses and improve patient selection for customized therapies in a more accurate manner.^{6–9}

Notwithstanding the conventional prognostic variables, systemic inflammation has been deemed to be a crucial ingredient of the tumor microenvironment that plays remarkable roles in tumor growth, progression, and metastasis steps.¹⁰ Several inflammation-based biomarkers including C-reactive protein and albumin are likewise respected as the reliable indicators of the host immune-nutritional status which might be utilized to predict the prognosis for various malignancies during chemotherapy, CRT, or the postoperative period.^{11–13} The prognostic nutritional index (PNI), calculated by joining the serum albumin levels and serum lymphocyte count was first introduced as an indicator of postoperative complications after gastrointestinal surgery, and therefore, was reported to link with survival outcomes and immune-nutritional status in several cancer types.^{14–17} The PNI assuredly evaluates the potential impact of the blend of hypoalbuminemia and lymphocytopenia. Hypoalbuminemia does not merely symbolize a status of nutritional deprivation but also indicates an increased systemic inflammation status, which is almost perpetually associated with elevated C-reactive protein levels. Lymphocytes are the critical cellular members of the immune and inflammation systems which possess vital local and systemic immune/inflammation functions. In this respect, lymphocytopenia indicates a markedly depressed inflammatory immune response and resultant poor disease prognosis.^{18,19} Even though the value of PNI has been assessed in various

stages of NSCLC previously, to our best knowledge, the strength of PNI has never been studied before in a homogenous patient group comprised only of stage IIIB NSCLC patients undergoing definitive CRT. For this reason, we herein aimed to objectively evaluate the prognostic significance of PNI for patients with stage IIIB-NSCLC who underwent CRT.

Materials and Methods

Patient Selection

Patients meeting the following inclusion criteria were retrospectively analyzed: 1) histologically confirmed to have adeno- or squamous cell carcinoma; 2) clinical stage IIIB according to the seventh TNM classification of lung cancer; 3) Eastern Cooperative Oncology Group (ECOG) performance status score of 0–1; 4) body-mass index with ≥ 20.0 kg/m²; 5) no history of other cancers; 6) no previous history of radiotherapy or chemotherapy; 7) available electronic patient data; 8) available pretreatment blood tests, including albumin and lymphocyte counts collected within two weeks of CRT; 9) available chest computerized tomography and fluorodeoxyglucose-positron emission/computed tomography (FDG-PET/CT) scans; and 9) no evidence of brain metastasis on magnetic resonance imaging acquired within one month of the treatment. Patients who received induction chemotherapy or immunotherapy at any disease stage were excluded from the analysis.

Ethics, Consent and Permissions

The design of the present study was approved by the institutional review board of Baskent University Medical Faculty before acquisition of any patient data. All patients provided written informed consent before the commencement of treatment either themselves or legally authorized representatives for collection and analysis of blood samples, pathologic specimens, and publication of their results.

Concurrent CRT

Target volumes were determined according to the co-registered planning computed tomography and FDG-PET/CT scans. Treatment techniques have been reported elsewhere.²⁰ Briefly, all patients received 60–66 Gy in 30–33 fractions for 5 days per week concurrently with 1–3 cycles of cisplatin (80 mg/m²) combined with either of docetaxel: CD combination) or vinorelbine (30 mg/m²,

D1, 8: CV combination). Elective nodal irradiation was not performed.

Prognostic Nutritional Index (PNI)

PNI was calculated as follows: $10 \times \text{albumin concentration (g/dL)} + 0.005 \times \text{total lymphocyte counts (per mm}^3\text{) of peripheral blood}$.¹⁴ Blood samples were obtained at a maximum period of 2 weeks before CRT due to the half-lives of albumin (≈ 21 days) and lymphocytes (> 2 weeks).²¹

Toxicity and Treatment Response Assessments

During CRT, patients were examined weekly for toxicity. Acute (≤ 90 days after CRT) and late (> 90 days) toxicities were assessed according to the Common Terminology Criteria for Adverse Events (CTCAE) v3. Post-CRT follow-up was performed every three months for the first two years post-treatment and then every six months or more often thereafter.

The first treatment response, as assessed by FDG-PET/CT, was compared to pre-CRT scans at the 12-week follow-up visit. In the case of progression or relapse, this was repeated for the subsequent chest computed tomography or abdominal ultrasound scans. Treatment response was based on EORTC-1999 guidelines and the PET Response Criteria in Solid Tumors (PERCIST) after 2009.

Statistical Analysis

The primary outcome was the clinical influence of pre-CRT PNI values on OS. The cut-off value for PNI, which may correlate with survival outcomes, was identified using a receiver operating characteristic²² curve. Secondary endpoint included the relation between pre-CRT PNI values and locoregional progression-free survival (LRPFS) and progression-free survival (PFS). The intervals between the first day of CRT and the related endpoints, including the date of recurrence/progression, death, or last follow-up, were used to calculate survival times. Medians and ranges were utilized for continuous variables, while frequency distributions were used for categorical variables. Frequency distributions were compared using Chi-square tests, Student's t-tests, Pearson's X^2 , and Spearman correlations. The influence of potential risk factors on OS, LRPFS, and PFS was assessed with Kaplan-Meier curves and Log rank tests. Multivariate analysis was utilized to identify independent prognostic variables with a stepwise Cox proportional hazards regression model. $P < 0.05$ was considered statistically significant.

Results

Patient Characteristics

A total of 358 patients with stage IIIB-NSCLC were included. Baseline clinicopathological patient characteristics for the entire study population and per PNI group are summarized in Table 1. The median age of patients was 61 years (range: 29–80 years), and 66.5% of the patients were male. All patients had an ECOG performance status of 0–1, and approximately half of the cohort (50.5%) had basal weight loss $> 5\%$. Furthermore, approximately half of the patients ($n = 188$; 52.5%) had adenocarcinoma, while 180 (47.5%) had squamous cell carcinoma.

Selection of Cut-off Values for PNI

ROC analysis was used to determine a cut-off value for PNI that was linked with survival outcomes. This yielded optimal cut-off values of 40.5, 40.3, and 40.6 for OS (area under the curve [AUC]: 84.1%, sensitivity: 75.9%, specificity: 72.4%), LRPFS (AUC: 92.4%, sensitivity: 87.9%, specificity: 85.1%), and PFS (AUC: 80.1%, sensitivity: 73.7%, specificity: 71.6%), respectively (Figure 1). Because the three values were nearly identical, a common cut-off value of 40.5 was used for further analyses. Therefore, patients were categorized into two groups defined as $\text{PNI} > 40.5$ or $\text{PNI} \leq 40.5$, which described 190 (53%) and 168 (47%) patients, respectively.

Association of PNI with Clinicopathological Characteristics

The distributions of patient demographics based on PNI level are shown in Table 1. Patients in the $\text{PNI} \leq 40.5$ group were more likely to have higher T (T3–4 vs T1–2; $P = 0.001$) and TN (T1–2N3 vs T3–4 N2; $P = 0.004$) stages.

PNI and Survival Outcomes

The median follow-up time was 22.5 months (range: 2.4–123.5). During the final analysis, 108 patients (30.2%) were alive and 14% ($n = 50$) were free of disease progression. For the entire population, the estimated median OS, LRPFS, and PFS were 25.2 (95% confidence interval [CI]: 36.3–46.6), 15.4 (95% CI: 26.6–35.3), and 10.7 months (95% CI: 36.8–69.9), respectively. Importantly, PNI-based stratification demonstrated that patients with $\text{PNI} \leq 40.5$ had significantly lower median OS (16.8 vs 36.7; $P < 0.001$), LRPFS (11.5 vs 19.5; $P < 0.001$), and DFS (8.6 vs 13.6; $P < 0.001$) relative to the higher PNI group (Table 2, Figure 2). This

Table 1 Baseline Characteristics of Patients According to PNI

Characteristic	All Patients (n=358)	PNI≤40.5 (n=190)	PNI>40.5 (n=168)	P-value
Median age (years) Range	61 29–80	63 34–78	60 29–80	
Age Group, N (%) ≤70 years >70 years	272 (76.0) 86 (24.0)	145 (40.5) 45 (12.5)	127 (35.5) 41 (11.5)	0.71
Gender, N (%) Female Male	120 (33.5) 238 (76.5)	63 (17.5) 127 (35.5)	57 (16.0) 111 (31.0)	0.48
ECOG Performance, N (%) 0 I	150 (42.0) 208 (58.0)	84 (23.5) 106 (29.5)	66 (18.5) 102 (28.5)	0.20
Histology, N (%) SCC AC	170 (47.5) 188 (52.5)	92 (25.7) 98 (27.3)	78 (22.0) 90 (25.0)	0.39
T-Stage, N (%) T1–2 T3–4	94 (26.2) 264 (73.8)	39 (10.9) 151 (42.1)	55 (15.4) 113 (31.6)	0.04
N-Stage, N (%) 2 3	69 (19.3) 289 (80.7)	38 (10.6) 152 (42.4)	31 (8.7) 137 (38.3)	0.41
TN Stage, N (%) T1–2N3 T3–4N2–3	94 (26.3) 264 (73.7)	39 (10.9) 151 (42.2)	55 (15.3) 113 (31.6)	0.004
Chemotherapy Cycles, N (%) 1 2 3	71 (19.8) 134 (37.5) 153 (42.7)	45 (12.6) 70 (19.5) 75 (20.9)	26 (7.3) 64 (17.9) 78 (21.8)	0.49

Abbreviations: PNI, Prognostic nutritional index; ECOG, Eastern Cooperative Oncology Group; SCC, Squamous cell carcinoma; AC, Adenocarcinoma; N-stage, Node stage; T-stage, Tumor stage.

corresponded to 5-year OS, LRPFS, and PFS rates of 12.3% vs 31.3%, 7.8% vs 24.8%, and 6.2% vs 22.5%, respectively.

Prognostic Analysis of Parameters

Univariate analysis revealed that lower OS rates were significantly associated with higher T stage (T3–4 vs T1–2; $P < 0.001$), higher N stages (N3 vs N2; $P = 0.004$) and lower PNI (< 40.5 vs ≥ 40.5 ; $P < 0.001$), which altogether retained their independent significance in multivariate analysis (Table 2).

Discussion

The results of the present study uncovered that pre-treatment PNI is an independent novel prognostic tool that efficiently laminates stage IIIB NSCLC patients into

two distinct prognostic groups following definitive CRT. Particularly, $PNI \leq 40.5$ was linked with lower median OS (16.8 vs 36.7 months; $P < 0.001$), LRPFS (11.5 vs 19.5; $P < 0.001$), and PFS (8.6 vs 13.6; $P < 0.001$) outcomes compared to $PNI > 40.5$ counterpart.

A growing body of evidence proposes that basic nutritional status and systemic inflammation, the key determinants of host status and distinctive features of cancer progression and metastasis are connected with the long-term prognosis of cancer patients.^{23–25} Importantly, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, and concentration of C-reactive protein are some of the indices that can be employed to monitor this concept.^{6,26} Another immune-nutritional biomarker is PNI, which consolidates absolute lymphocyte count and albumin. Importantly,

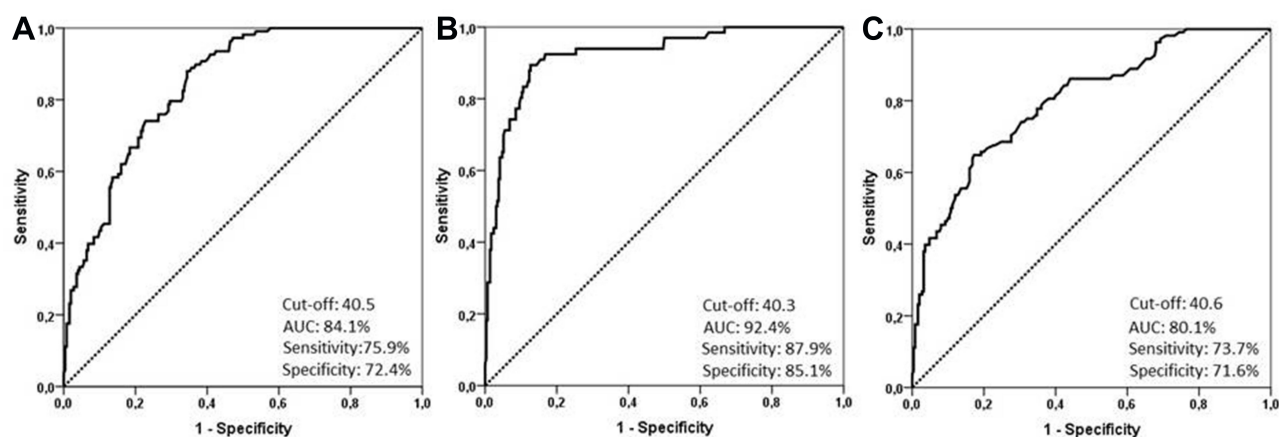


Figure 1 Receiver operating characteristic curve analysis for the optimal cut-off value of PNI. (A) overall-survival, (B) locoregional progression-free survival, (C) progression-free survival.

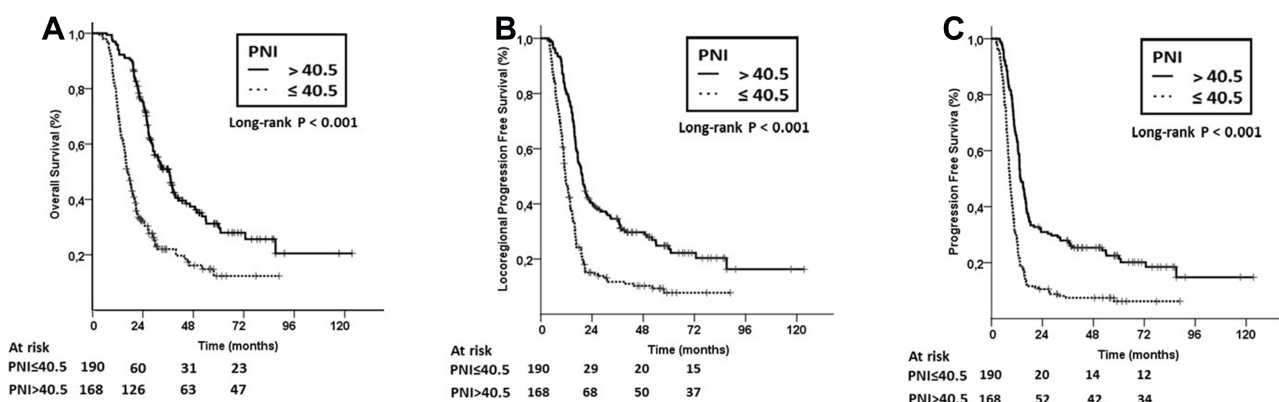


Figure 2 Survival outcomes according to PNI. (A) Overall survival; (B) Locoregional progression-free survival, (C) Progression-free survival.

following a milestone study by Onodera et al, further investigations disclosed that PNI is associated with survival outcomes in various malignancies.^{4,14-17,27-30} Critically, while

past examinations have meticulously researched the relationship among the PNI and NSCLC, these studies used eligibility criteria that included patients with a considerable

Table 2 Outcomes of Univariate and Multivariate Analyses

Variable	OS			LRPFS			PFS		
	Univariate P-value	Multivariate P-value	HR	Univariate P-value	Multivariate P-value	HR	Univariate P-value	Multivariate P-value	HR
Age group (<70 vs ≥70 y)	0.58	-	-	0.47	-	-	0.63	-	-
Gender (F vs M)	0.91	-	-	0.85	-	-	0.66	-	-
ECOG (0 vs 1)	0.76	-	-	0.62	-	-	0.78	-	-
Histology (SCC vs AC)	0.74	-	-	0.95	-	-	0.86	-	-
T-stage (T1-2 vs T3-4)	< 0.001	< 0.001	2.14	0.007	0.009	1.68	0.002	< 0.001	1.87
N-stage (2 vs 3)	< 0.001	0.008	1.41	0.014	0.019	1.26	0.007	0.003	1.97
Anemia (Absent vs Present)	< 0.001	< 0.001	1.93	< 0.001	< 0.001	2.28	< 0.001	< 0.001	1.71
Weight loss (< 5% vs ≥5%)	< 0.001	< 0.001	4.64	< 0.001	< 0.001	4.1	< 0.001	< 0.001	6.5
PNI (>40.5 vs ≤40.5)	< 0.001	< 0.001	2.54	< 0.001	< 0.001	3.18	< 0.001	< 0.001	3.44

Abbreviations: OS, Overall survival; LRPFS, Locoregional progression-free survival; PFS, Progression-free survival; HR, Hazard ratio; F, Female; M, Male; ECOG, Eastern cooperative oncology group; AC, Adenocarcinoma; SCC, Squamous cell carcinoma; N-stage, Node stage; T-stage, Tumor stage; PNI, prognostic nutritional index.

degree of heterogeneity in terms of disease stage, histological subtypes and treatments.^{31–33} Such non-uniformities restrict the judicial interpretation of the actual prognostic worth of PNI in this patient population.⁴ Therefore, we investigated the prognostic ability of PNI in a relatively homogeneous group comprised exclusively of stage IIIB NSCLC patients treated with exclusive CRT.

Our most noticeable finding was the noteworthy relationship between $\text{PNI} \leq 40.5$ and poor median OS (16.8 vs 36.7 months; $P < 0.001$) relative to patients with $\text{PNI} > 40.5$. Albeit different PNI cut-off values have been reported previously for NSCLC patients, again these studies were restrained by heterogeneous patient attributes which hindered the ability to reveal the precise relationship between the specified PNI cut-offs and survival outcomes.^{34,35} For instance, Kos et al reported that the mean OS for patients with $\text{PNI} < 49.5$ and ≥ 49.5 were 7 and 33 months in a sum of 138 NSCLC patients, respectively.³⁴ Nonetheless, patients were categorized according to the median cut-off value rather than on a more reliable statistical tool, such as the ROC curve analysis. Moreover, the study population included patients with heterogeneous disease stages ranging from stage I to IV, and only 15% of them received CRT as the primary treatment. In another study incorporating 144 patients with epidermal growth factor receptor (EGFR) mutations who were treated with EGFR tyrosine kinase inhibitors, $\text{PNI} < 48.78$ was significantly associated with poor survival rates, increased systemic inflammation, and ominous clinical outcomes.³⁵ By marked contrast, our study population was comparatively more homogenous both in terms of disease stage and treatment modality, whereby only a single CRT protocol with identical radiotherapy doses was used. Additionally, the use of PET/CT for staging and radiotherapy planning may have afforded more accurate patient stratification in terms of staging and the ideal choice of the initial definitive therapy as either CRT or induction chemotherapy.

Like the results for OS, patients with $\text{PNI} \leq 40.5$ also had significantly lower PFS (8.6 vs 13.6 months; $P < 0.001$) and LRPFS (11.5 vs 19.5 months; $P < 0.001$) rates relative to patients with $\text{PNI} > 40.5$. Although the definite reason for this link remains obscure, these data indicate that PNI can be used to identify the patients who are more likely to develop metastasis and loco-regional recurrences. Therefore, PNI might be a useful tool for this patient population. Formerly, a study involving surgically treated NSCLC patients reported a significant correlation between low PNI and larger tumor size concerning the tumor aggressiveness and therefore, more frequent relapses.³³ While

patients are commonly stratified based on TNM staging as a measure of disease extent, this strategy is constrained by the fact that TNM-7 staging includes a retrospective database that lacks the validity of existing T stages and does not consolidate PET/CT as a functional staging tool.³⁶ Although our present analysis was performed on a relatively homogeneous cohort that, according to the AJCC-7 criteria, only included stage IIIB patients, the demonstration of significantly distinct outcomes between the PNI-stratified groups emphatically features the prescient viability of factors beyond the classic TNM conventions, including the immune-nutritional marker PNI.

The ability to accurately stratify patients with comparative prognosis to customize treatment strategies without a doubt relies upon objective and accurate prognostic tools.³⁶ Accordingly, accessible previous literature and the current data altogether indicate that PNI has robust prognostic utility.⁴ Although the underlying exact mechanism remains unclear, two ingredients of PNI, namely albumin and absolute lymphocyte count³⁷ are well-recognized measures of nutrition, immunity, and systemic inflammation.²⁷ On the other hand, based on the equation used to calculate PNI ($10 \times \text{albumin} + 0.005 \times \text{ALC}$); the resultant score is affected basically by the albumin levels, rather than the ALC. Nevertheless, considering the immune and nutritional features of albumin, this does not lessen the prognostic quality of PNI with regards to the systemic immunity. Thus, reduced albumin levels ought to be considered not only for the corresponding effect of increased catabolism but also as a reflection of increased systemic inflammation, which is consequently associated with poor survival outcomes.³⁸

As an intriguing issue of current oncologic practice, integration of various immunotherapeutics such as immune checkpoint inhibitors to the radiotherapy is proved to remodel the tumor microenvironment and enhance the presentation of neoantigens, upregulation of tumoral programmed death ligand-1 (PD-L1) and major histocompatibility complex class 1 (MHC-C1) expression.^{39–41} Recently, durvalumab, a selective IgG1 monoclonal antibody which blocks PD-L1 binding to PD-1 and CD-80 allowing T cells to recognize and kill tumor cells, has been approved as the adjuvant standard of care after CRT with Level 1 proof for treatment of unresectable NSCLC.⁴² To our best information, to date, no study particularly addressed the prognostic significance of PNI in NSCLC patients treated with the standard CRT followed by durvalumab or other immunotherapeutics. Nevertheless, neutrophil to lymphocyte ratio which is another inflammation index has been

addressed as a prognostic indicator in some limited studies,^{43–45} and a meta-analysis.⁴⁶ Reputably, Jiang et al conducted a comprehensive meta-analysis literature search to assess the relationship between pretreatment neutrophil to lymphocyte ratio and OS or PFS in advanced-stage cancer patients treated with immunotherapy. The pooled results of this meta-analysis of 27 studies with 4647 patients unveiled that high pretreatment neutrophil to lymphocyte ratio was closely linked with significantly shorter OS (HR = 1.98; $P < 0.001$) and PFS (HR = 1.78; $P < 0.001$). In subgroup analyses, results confined to the advanced NSCLCs demonstrated that high pretreatment neutrophil to lymphocyte ratio was robustly connected with meaningfully shorter OS (HR = 2.07; $P < 0.001$) and PFS (HR = 1.50; $P = 0.005$) in this specific patients' group as well. Albeit our study population included patients with conventional chemotherapy regimens, because the albumin and lymphocyte counts are closely associated with the patients' nutritional, inflammation, and immune status at any time point, it appears rational to anticipate that PNI may likewise assist useful in locally advanced NSCLC patients undergoing standard CRT followed by the adjuvant immunotherapy. However, the potential prognostic worth of PNI in this particular treatment strategy needs to be carefully investigated to achieve concluding remarks on this interesting issue of foremost significance.

This study had several strengths like the embodiment of a relatively large population with the exclusive histological subtypes of adenocarcinoma and squamous cell carcinoma. Second, PET/CT for staging and treatment response assessment was performed consistently for the whole cohort. Third, the exclusion of patients with induction chemotherapy may have limited the unforeseeable potential inclinations. Alternatively, our study had some impediments as a retrospective and a single-institutional cohort. First, other medical conditions, including infection, non-malignant inflammation, drugs, and patient stress, are eccentric factors that may have influenced the levels of albumin and leucocytes. Second, the lack of molecular characterization may introduce some potential bias regarding the improved survival rates in patients with epidermal growth factor receptor mutation, anaplastic lymphoma kinase, and programmed cell death-1/programmed cell death ligand-1. Third, considering the dynamic pattern of PNI, not only the baseline PNI, but also the impact of the PNI changes between the CRT and post-CRT periods, may likewise have altered the results presented here. However, this issue has been investigated in a group of 261 patients

with locally advanced rectal cancer, where the patients were stratified arbitrarily into three groups according to the PNI difference (dPNI) between the neo-adjuvant CRT and pre-surgical measurements: dPNI < 5 ; dPNI of 5–10 and dPNI > 10 ; the dPNI was found to be firmly linked with survival outcomes.⁴⁷ Finally, our results ought not to be generalized to all stage IIIB NSCLC patients as they are restricted to a highly selected patients group with ECOG scores of 0–1, < 80 years of age and BMI ≥ 20 kg/m².

Conclusions

To our knowledge, this study is the first to demonstrate the efficacy of PNI in predicting survival outcomes in patients with stage IIIB NSCLC undergoing definitive CRT. Accordingly, our results demonstrated that the pre-treatment PNI is an independent novel prognostic tool that efficiently stratifies stage IIIB NSCLC patients into two distinct prognostic groups at the PNI ≤ 40.5 value following definitive CRT with regards to the OS, LRPFS, and PFS outcomes.

Data Sharing Statement

Data is owned and saved by Baskent University Medical Faculty and are available from the Baskent University Institutional Data Access/Ethics Committee (contact via Baskent University Ethics Committee) for researchers meeting the criteria for access to confidential data: contact address, adanabaskent@baskent.edu.tr.

Ethics and Consent Statement

The design of the present study was approved by the institutional review board of Baskent University Medical Faculty before acquisition of any patient data. All patients provided written informed consent before the commencement of treatment either themselves or legally authorized representatives for collection and analysis of blood samples, pathologic specimens, and publication of their results.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no funding and no conflicts of interest in this work.

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