Original Article

The prognostic value of prognostic nutritional index (PNI) and neutrophil to lymphocyte ratio (NLR) for advanced non-small cell lung cancer treated with platinum-based chemotherapeutics

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Background: The present study aimed to investigate the relationship between prognostic nutritional index (PNI) and peripheral blood neutrophil to lymphocyte ratio (NLR), and the prognosis of patients with advanced non-small cell lung cancer (NSCLC) treated with platinum-based therapeutics.

Methods: The data of 99 advanced NSCLC patients treated with platinum chemotherapeutics between January 2011 and June 2019 were retrospectively analyzed. The association between PNI and NLR and the clinicopathological characteristics of the patients was examined. The patients were randomized into high or low groups according to PNI and NLR. The predictive value of PNI and NLR for overall survival (OS) was evaluated by receiver operating characteristic (ROC) curve analysis. Univariate and multivariate Cox proportional hazards regression analyses were performed to investigate the prognostic factors of advanced NSCLC patients treated with platinum-based chemotherapeutics. The association between PNI and NLR and progression-free survival (PFS) or OS was determined using the Kaplan-Meier method and compared between groups using the log-rank test.

Results: The ROC curve analysis determined the optimal cut-off values of PNI and NLR for predicting OS to be 52.525 and 3.525, respectively. Univariate analysis indicated that low Karnofsky performance scale (KPS) score (P=0.005), poor tumor differentiation (P=0.022), brain metastasis (P<0.001), and low PNI (P=0.001) were independent risk factors for PFS in patients with advanced NSCLC; however, there was no significant correlation observed between NLR (P=0.082) and PFS in patients with advanced NSCLC. Low KPS score (P=0.003), poor tumor differentiation (P=0.001), brain metastasis (P<0.001), low PNI (P<0.001), and high NLR (P=0.046) were significantly associated with shorter OS. Furthermore, Cox multivariate analysis revealed that brain metastasis (P=0.005) and low PNI (P=0.008) were significant independent prognostic factors for PFS, while brain metastasis (P=0.003) and low PNI (P=0.028) were also found to be significant independent risk factors for poor OS.

Conclusions: PNI is a reliable, simple, easily available, and inexpensive biomarker for predicting the prognosis of advanced NSCLC patients treated with platinum-based chemotherapeutics in routine clinical practice. Furthermore, PNI is superior to NLR in as a prognostic indicator for advanced NSCLC patients treated with platinum-based chemotherapeutics.

Keywords: Prognostic nutritional index (PNI); neutrophil to lymphocyte ratio (NLR); lung neoplasms; efficacy of chemotherapy; overall survival time (OS time)

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Introduction

Lung cancer continues to be the most frequently diagnosed malignant tumor in the world, and is the leading cause of cancer-associated mortality (1). The predominant histologic subtype of lung cancer, non-small cell lung cancer (NSCLC), constitutes approximately 80–85% of all lung cancer cases. Currently, surgical resection is established as the gold standard in first-line treatment for early-stage NSCLC patients. However, in the majority of cases, NSCLC is initially diagnosed at the advanced stage, at which point surgical resection alone cannot provide a complete cure. For patients with advanced NSCLC, platinum-based chemotherapy remains the standard of care (2,3). Overall, the prognosis for these patients is poor, and little improvement has been observed in survival over the past few decades.

NSCLC treatment decisions are typically based on the patient's health status and the crucial prognostic factors include stage, histological subtype, cell differentiation, and the molecular characteristics of NSCLC. Late TNM stage, poor tumor differentiation and no mutation of EGFR are generally recognized as the poor prognostic factors of NSCLC. However, at present, patients who are receiving the same treatment strategy cannot be significantly stratified according to these and other clinicopathological characteristics. Therefore, the identification of promising, accessible and reliable prognostic predictive factors by which to stratify patients is of great significance.

An increasing number of studies have reported that immunological status, comprising inflammatory status and nutritional status, remains a significant predictive factor for the prognosis of patients with malignant tumors. Prognostic nutritional index (PNI), a simple index which is calculated by combining the serum albumin concentration and total peripheral blood lymphocyte count, has been increasingly applied to assess the immune-nutritional status of patients who undergo surgery. Multiple studies have suggested that PNI can facilitate effective evaluation of the prognosis of patients with various cancers, including stomach (4), colorectal (5), breast (6), and cervical cancer (7). Moreover, locoregional tumor cell growth, tumor cell metastasis, and tumor immunity suppression are promoted by systemic inflammatory response (8), in which neutrophils and lymphocytes serve as important components. Neutrophil to lymphocyte ratio (NLR), an index of inflammation, has been extensively studied for its role in cancer prognosis. However, there is a paucity of literature regarding the impact of PNI and NLR in the prognosis of advanced NSCLC patients following platinum-based chemotherapy. Therefore, the present study was initiated to investigate the clinical significance of PNI and NLR in predicting the prognosis of patients with advanced NSCLC who receive platinum-based chemotherapy.

Methods

Study subjects

This retrospective study analyzed patients with advanced NSCLC who received chemotherapeutic treatment in the Department of Oncology of the Fifth People's Hospital of Changshu, China in the period between January, 2011 and June, 2019.

Patients who met the following criteria were included: (I) histologically confirmed primary NSCLC; (II) had undergone complete blood laboratory and blood biochemical investigation in the week preceding the commencement of chemotherapy; (III) no previous history of tumor-related treatment; and (IV) had complete follow-up data. Patients who met any of the following criteria were excluded: (I) had experienced infection in the 2 weeks prior to surgery; (II) had received hormonal, non-steroidal anti-inflammatory, granulocyte colony-stimulating factor or other drug therapies in the month before treatment; (III) presented with comorbidities including coronary heart disease, rheumatoid disease, diabetes, and other diseases; (IV) patients with malignancy in other organs or hematological diseases; (V) a follow-up time of less than 3 months or loss to follow-up; or (VI) patients with digestive tract diseases affecting the digestion and absorption of food.

Data collection

Clinicopathological characteristics data were retrieved

from the patients' electronic medical records, including gender, age, histological type, tumor differentiation, chemotherapy regimen, Karnofsky performance scale (KPS) score, smoking history, brain metastasis, blood laboratory investigations, and biochemical indexes within the 1 week before treatment. Two mL of peripheral blood venous blood samples were collected by EDTA-K2 anticoagulant vacuum test tube, and the venous blood in the tube was quickly mixed with the anticoagulant. Mindray BC-6800 blood cell analyzer was used to select the automatic whole blood model to analyze the samples in the state of readiness for counting, and various indexes of complete blood count were obtained. Five mL of peripheral venous blood samples were collected by coagulant stimulating vacuum test tube, and the serum was centrifuged by a centrifuge. The biochemical indexes were determined by the Toshiba TBA-120 automatic biochemical analyzer. The values of PNI and NLR were calculated based on the test indices. PNI was calculated by serum albumin value (g/L) + 5 × peripheral blood lymphocyte count ($\times 10^9$/L), and NLR was defined as the neutrophil count divided by the lymphocyte count.

Follow-up

All patients were administered systemic platinum-based chemotherapy. Each patient attended regular follow-ups until June 2019 or death. Follow-up examinations were performed at regular 3-month intervals in the first-year post-chemotherapy, 6-month intervals over the subsequent 2 years, and on an annual basis thereafter. After the treatment was completed, regular follow-up was performed, and the curative effect was evaluated according to the response evaluation in solid tumors (RECIST) evaluation criteria. Tumor response was classified as: complete remission (CR), partial remission (PR), disease stability (SD), or disease progression (PD). Progression-free survival (PFS) was defined as the period from the date of initial pathological diagnosis to the date of PD, death because of any cause, or the date of last follow-up (months). Overall survival (OS) time was calculated as the period from the first date of pathological diagnosis to the date of death or last follow-up (months).

Statistical analysis

Continuous variables were expressed as mean ± standard deviation, and differences between groups were compared through one-way analysis of variance. Categorical variables were expressed as number and percentage, with differences between groups determined using the χ^2 test. The hematological index values of the patient study were considered as the variable and the short-term response of platinum-based chemotherapy as the end-point. The optimal cutoff values were determined by using the receiver operating characteristic (ROC) curve to predict OS and PFS. Survival curves were calculated by the Kaplan-Meier method, and the survival curves were compared using the log-rank test. Multivariate analysis was carried out with Cox proportional hazards model, and all of the variables found to be significant in univariate analysis were entered into the multivariate analysis. All statistical analysis was performed using Statistical Package for the Social Sciences (SPSS, version 19.0; IBM Corp., Armonk, NY, USA).

Results

Clinicopathological characteristics of patients with advanced NSCLC following platinum-based therapy

Of 114 patients with advanced NSCLC who were initially enrolled in this study, 99 patients were ultimately included. The excluded patients included, 6 cases who had received antineoplastic therapy, 3 patients who had experienced infection in the 2 weeks before treatment, 5 patients who had received drugs that affected the results of blood laboratory examination 1 month before treatment, and 1 patient who had a tumor in another organ. The baseline clinicopathological characteristics of the eligible patients are summarized in *Table 1*.

Optimal cut-off values

The optimal cutoff values for the prediction of OS were 52.525 (P=0.023) and 3.525 (P=0.036) for PNI and NLR, respectively (*Figure 1*).

The association between PNI and NLR indices and the clinicopathological characteristics of patients with advanced NSCLC following platinum-based therapy

Based on the optimal cut-off values of PNI and for NLR described above, the patients were separated into two groups of high or low levels for PNI and NLR, respectively. Subsequently, differences in age, sex, smoking status, KPS

Table 1 Clinicopathological characteristics of patients with advanced NSCLC

Characteristics	N (%)
Age (years)	
<60	25 (25.3)
≥60	74 (74.7)
Gender	
Male	66 (66.7)
Female	33 (33.3)
Smoking history	
Smoker	53 (53.5)
Non-smoker	46 (46.5)
KPS score	
≥70	77 (77.8)
<70	22 (22.2)
Histological type	
Squamous	45 (45.5)
Adenocarcinoma	54 (54.5)
Tumor differentiation	
Poorly differentiated	43 (43.4)
Moderately-well differentiated	56 (56.6)
Brain metastasis	
Without brain metastasis	91 (91.9)
With brain metastasis	8 (8.1)
Chemotherapy regimen	
With cisplatin	51 (51.5)
With carboplatin	48 (48.5)
PNI	
≥52.525	45 (45.5)
<52.525	54 (54.5)
NLR	
<3.525	59 (59.6)
≥3.525	40 (40.4)

NSCLC, non-small cell lung cancer; KPS, Karnofsky performance scale; PNI, prognostic nutritional index; NLR, neutrophil to lymphocyte ratio.

score, tumor type, tumor differentiation, brain metastasis, and chemotherapy regimen were compared between the high and low groups for PNI and NLR. The results indicated that there were no significant correlations between PNI, NLR, and the above-mentioned clinicopathological characteristics (*Table 2*).

The association between PNI and NLR indices and the prognosis of patients with advanced NSCLC following platinum-based therapy

Univariate and multivariate survival analyses of PFS in patients with advanced NSCLC

Univariate analysis revealed low KPS score, poor tumor differentiation, brain metastasis, and low PNI to be significant prognostic factors for reduced PFS in patients with advanced NSCLC; however, there was no significant correlation between NLR and PFS in patients with advanced NSCLC (*Figure 2*). Multivariate analysis indicated that brain metastasis and low PNI were significant independent prognostic factors of poor PFS (P=0.005 and P=0.008, respectively; *Table 3*).

Univariate and multivariate survival analysis of OS in patients with advanced NSCLC

Univariate analysis revealed that low KPS score, poor tumor differentiation, brain metastasis, low PNI, and high NLR were significantly correlated with reduced OS (*Figure 3*). Further multivariate analysis indicated that brain metastasis and low PNI were significant prognostic factors of poor OS (*Table 4*).

Discussion

Platinum-based chemotherapy has taken up its places a first-line therapy for advanced NSCLC; however, the development of chemotherapy resistance is inevitable in patients with the disease, which presents a significant obstacle in effective tumor management (9,10). Clinical decision-making for the treatment of advanced NSCLC patients is dependent on appropriate prognostic indicators, which can guide clinicians in predicting the efficacy of anti-tumor therapy. Therefore, this study investigated

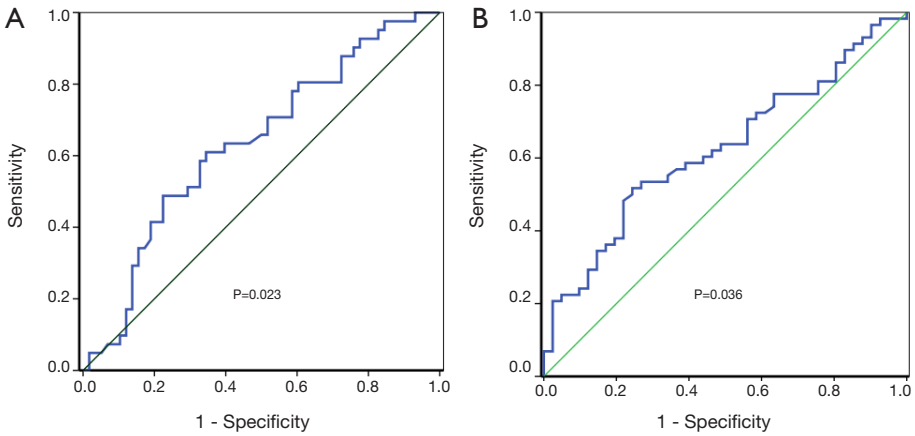

Figure 1 The ROC analysis of PNI and NLR to predict the prognosis of advanced NSCLC patients treated with platinum-based chemotherapeutics. (A) The ROC curve analysis of pre-treatment PNI in predicting the prognosis of advanced NSCLC patients (0.023); (B) the ROC curve analysis of pre-treatment NLR in predicting the prognosis of advanced NSCLC patients (0.036). ROC, receiver operating characteristic; PNI, prognostic nutritional index; NLR, neutrophil to lymphocyte ratio; NSCLC, non-small cell lung cancer.

the prognostic significance of NLR and PNI as markers of systemic inflammation in patients with advanced NSCLC who received platinum-based chemotherapy. The results indicated that NLR value had a significant effect on the prognosis of these patients. Moreover, PNI and brain metastasis were also found to serve as independent prognostic factors for advanced NSCLC patients treated with platinum-based chemotherapy.

Immunological status, comprising nutritional status and inflammatory status, is of great significance to the survival of patients with various cancer types, including NSCLC. PNI and NLR reflect the patient's immunonutritional status and inflammation status, respectively. Both the PNI and NLR indices are accurate, inexpensive, highly reproducible, and widely used blood-based investigations.

PNI, which was originally proposed by Smale *et al.* (11), predominantly evaluates the risk of recurrence and survival following surgical treatment; however, owing to the complex calculation it entails, it was not taken up explicitly at that time. In 1984, Onodera *et al.* simplified the formula for the calculation of PNI, which was calculated based on the two indices of serum albumin and lymphocyte count (12). PNI was once used to evaluate the nutritional and immune status of gastrointestinal surgery patients. In recent years, an increasing number of studies have advocated the use of PNI evaluation for the prognosis of patients with malignant tumors, including lung cancer; moreover, the ability of PNI to predict the outcome of patients with tumors, regardless of the location and primary site of origin of the tumor, has also been presented (4,13-16).

Alterations in metabolic and nutritional rate, including malnutrition and metabolic rate, can significantly influence the survival and recovery of cancer patients. Notably, serum albumin deficiency represents both poor nutritional status and poor prognosis (17,18). As important immune cells, lymphocytes play a crucial role in immune surveillance through their inhibition of the proliferation, invasion, and migration of tumor cells (19,20). Furthermore, malnutrition and an impaired immune system can collectively influence tolerance and response to chemotherapeutic treatments, which can potentially lead to reduced survival in cancer patients (21,22).

Because relatively few studies have examined PNI in patients with NSCLC, the optimal cut-off value for PNI remains undefined. Due to heterogeneity among patents and low sample sizes, the cut-off values vary among different studies. In our study, the optimal cut-off value of PNI, which was calculated based on the ROC curve, was 52.525. The OS of NSCLC patients following platinum-based chemotherapy with PNI ≥52.525 was observed to be significantly higher than that of patients with PNI <52.525. The optimal cut-off value of PNI indicated by Shimizu *et al.* (23) was 50, which was lower than our 52.525, while the value reported by Jin *et al.* (24) was 53.85, which was higher than our PNI value. Moreover, based on multivariate analysis, PNI was found to be an independent prognostic factor in the present study. This finding is consistent with the results of Dai *et al.* (25) Furthermore, PNI has also been

Table 2 The association between clinicopathological characteristics of advanced NSCLC patients and high and low indices for PNI and NLR

Characteristics	PNI, n (%)			NLR, n (%)		
	≥52.525 (n=45)	<52.525 (n=54)	P value	≥3.525 (n=40)	<3.525 (n=59)	P value
Age (years)			0.768			0.672
<60	12 (26.7)	13 (24.1)		11 (27.5)	14 (23.7)	
≥60	33 (73.3)	41 (75.9)		29 (72.5)	45 (76.3)	
Gender			0.392			0.772
Male	28 (62.2)	38 (70.4)		26 (65.0)	40 (67.8)	
Female	17 (37.8)	16 (29.6)		14 (35.0)	19 (32.2)	
Smoking history			0.397			0.865
Smoker	22 (48.9)	31 (57.4)		21 (52.5)	32 (54.2)	
Non-smoker	23 (51.1)	23 (42.6)		19 (47.5)	27 (45.8)	
KPS score			0.52			0.125
≥70	39 (86.7)	38 (70.4)		28 (70.0)	49 (83.1)	
<70	6 (13.3)	16 (29.6)		12 (30.0)	10 (16.9)	
Histological type			0.854			0.455
Squamous	20 (44.4)	25 (46.3)		20 (50.0)	25 (42.4)	
Adenocarcinoma	25 (55.6)	29 (53.7)		20 (50.0)	34 (57.6)	
Tumor differentiation			0.064			0.163
Poorly differentiated	15 (33.3)	28 (51.9)		14 (35.0)	29 (49.2)	
Moderately-well differentiated	30 (66.7)	26 (48.1)		26 (65.0)	30 (50.8)	
Brain metastasis			0.637			0.861
Without brain metastasis	42 (93.3)	49 (90.7)		37 (92.5)	54 (91.5)	
With brain metastasis	3 (6.7)	5 (9.3)		3 (7.5)	5 (8.5)	
Chemotherapy regimen			0.941			0.510
With cisplatin	23 (51.1)	28 (51.9)		19 (47.5)	32 (54.2)	
With carboplatin	22 (48.9)	26 (48.1)		21 (52.5)	27 (45.8)	

NSCLC, non-small cell lung cancer; PNI, prognostic nutritional index; NLR, neutrophil to lymphocyte ratio; KPS, Karnofsky performance scale.

reported to be significantly correlated with gender and histology (26). The incidence of low PNI status in female patients with lung cancer has been revealed to be lower than in male patients. Similarly, low PNI has been found to be rarer in patients with adenocarcinoma than in those with non-adenocarcinoma. However, this is in contrast with the results of the present study. Considering the limited sample size of the present study, our results warrant further validation with a large sample size.

NLR, comprising neutrophil technique and lymphocyte count, serves as an effective biomarker for detecting the inflammatory state of the immune system (27). Neutrophils can contribute to the proliferation and survival of malignant cells and promote metastasis and angiogenesis by producing proangiogenic chemokines and growth factors (27,28). In contrast, lymphocytes produce cytokines, which play an important role in tumor defense and immune surveillance through the induction of cytotoxic cell death and inhibition of tumor cell proliferation and migration (29). NLR can reflect a balance between the protumor and antitumor

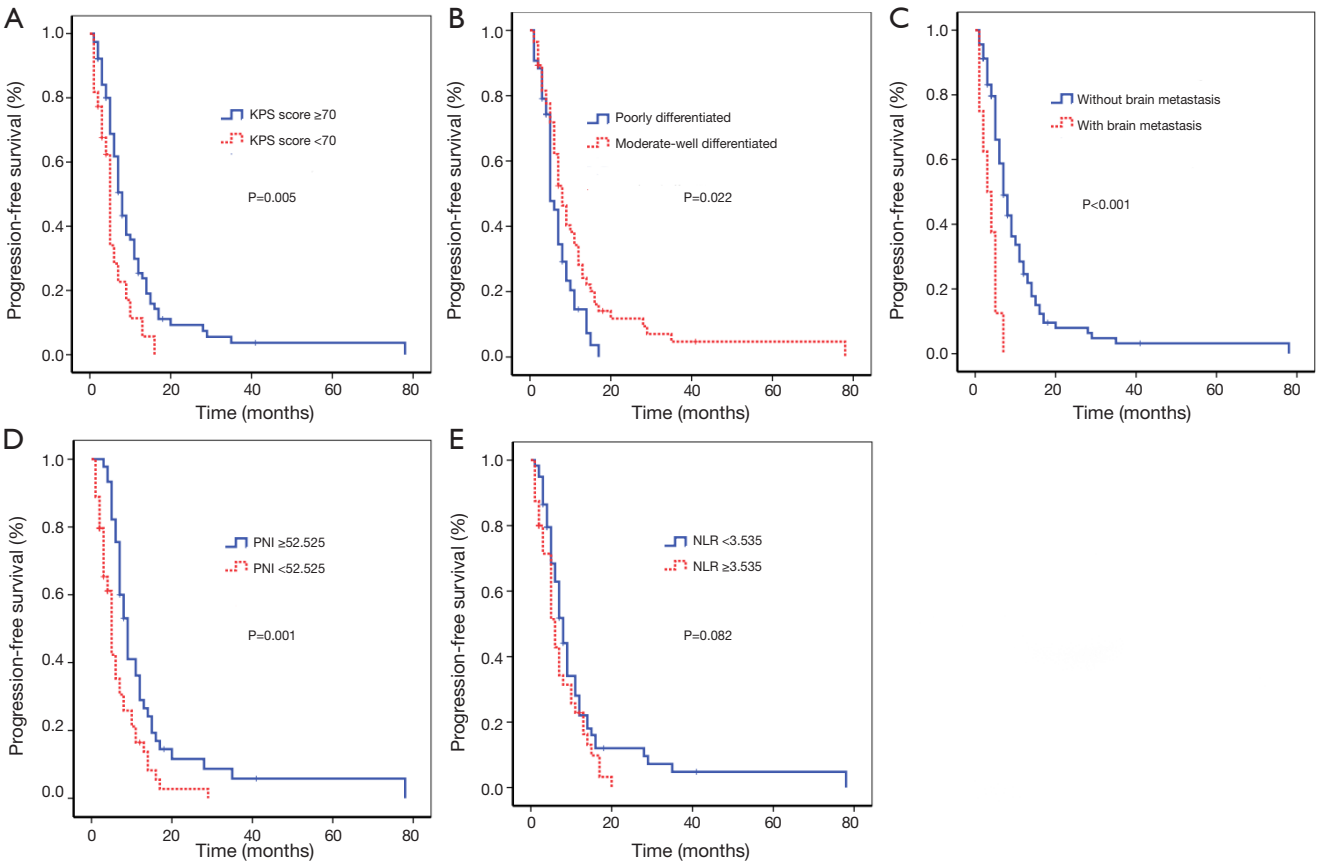

Figure 2 The association between the patients' clinicopathological characteristics and PFS. (A) The effect of KPS score on PFS (P=0.005); (B) the effect of differentiation degree on PFS (P=0.022); (C) the effect of brain metastasis on PFS (P<0.001); (D) the effect of PNI on PFS (P=0.001); (E) the effect of NLR on PFS (P=0.082). PFS, progression-free survival; KPS, Karnofsky performance scale; PNI, prognostic nutrition index; NLR, neutrophil to lymphocyte ratio.

inflammatory status of patients with cancer; thus, any alteration in neutrophil and lymphocyte counts can be associated with cancer progression (30,31).

Although univariate analysis of this study revealed NLR to be a significant prognostic factor for OS of patients with advanced NSCLC, multivariate regression analysis suggested that NLR is not an independent prognostic factor for OS in advanced NSCLC patients treated with platinum-based chemotherapy. Furthermore, this study also indicated that PNI is superior to NLR for the prognosis of patients with advanced NSCLC lung cancer who receive platinum chemotherapy. However, these findings are in contrast to the results of many previous studies (32-34). The differences in the findings might be attributed to the following: (I) variability in the number of cases, stage, and driver gene mutation status among the study subjects: All of the 99 patients in our study had stage IVNSCLC. However, the number of cases in the three studies mentioned varied from 109 to 1,225. In addition to patients with stage IV, these studies also included some patients with stage III disease. Besides this, we were unable to collect the complete data on patient-driver gene status due to the limited availability of data. A previous study by Zhang *et al.* included patients with EGFR mutations (33). In addition to patients with EGFR mutations, there were different proportions of EGFR-negative or patients with unknown EGFR-mutation status in the two studies (32,34). (II) The treatment scheme of the patients was different among different studies: we administered platinum-based chemotherapy. Zhang *et al.* treated patients with EGFR-TKI therapy, while the subjects in the other two studies (32,34) were prescribed nivolumab immunotherapy. (III) The time the peripheral

Table 3 Univariate and multivariate analyses of progression-free survival in the advanced NSCLC patients

Variables	N	MST (months)	Univariate			Multivariate			
			95% CI	χ^2	P value	RR	95% CI	χ^2	P value
Age (years)				0.037	0.848	–	–	–	–
≥60	74	11.543	7.285–15.802						
<60	25	9.520	5.846–13.194						
Gender				0.015	0.904	–	–	–	–
Male	66	10.552	6.893–14.212						
Female	33	9.333	6.443–12.223						
Smoking				1.977	0.160	–	–	–	–
Smoker	53	9.261	5.822–12.700						
Non-smoker	46	10.577	7.802–13.351						
KPS score				8.068	0.005	1.468	0.838–2.570	1.801	0.180
≥70	77	11.868	8.222–15.514						
<70	22	5.650	3.795–7.505						
Histological type				1.770	0.183	–	–	–	–
Squamous	45	8.238	5.917–10.559						
Adenocarcinoma	54	11.627	7.350–15.905						
Tumor differentiation				5.243	0.022	0.752	0.747–1.191	1.479	0.224
Poorly differentiated	43	6.911	5.563–8.259						
Moderately-well differentiated	56	12.917	8.273–17.560						
Brain metastasis				15.787	<0.001	3.188	1.426–7.126	7.977	0.005
With brain metastasis	8	3.500	2.018–4.982						
Without brain metastasis	91	11.207	8.023–14.391						
Chemotherapy regimen				0.400	0.527	–	–	–	–
With cisplatin	51	10.010	6.074–13.946						
With carboplatin	48	10.105	7.423–12.786						
PNI				11.510	0.001	1.829	1.172–2.856	7.057	0.008
≥52.525	45	14.418	9.037–19.800						
<52.525	54	6.775	5.071–8.478						
NLR				3.016	0.082	–	–	–	–
≥3.535	40	7.320	5.583–9.057						
<3.535	59	12.651	8.034–17.267						

NSCLC, non-small cell lung cancer; MST, mean survival time; KPS, Karnofsky performance scale; PNI, prognostic nutrition index; NLR, neutrophil to lymphocyte ratio; CI, confidence interval; RR, relative risk.

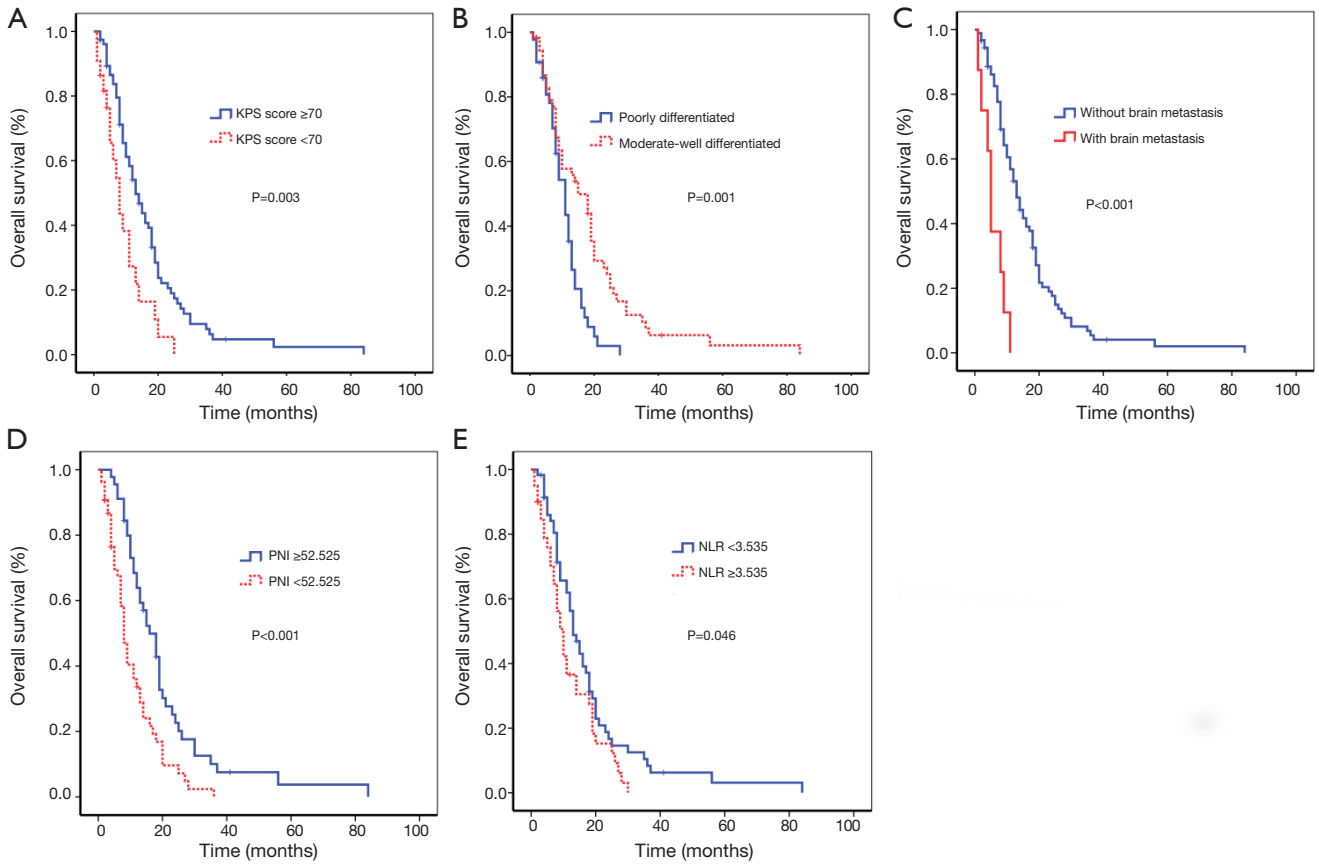

Figure 3 The association between clinicopathological characteristics and OS. (A) The effect of KPS score on OS (P=0.003); (B) the effect of differentiation degree on OS (P=0.001); (C) the effect of brain metastasis on OS (P<0.001); (D)the effect of PNI on OS (P<0.001); (E) the effect of NLR on OS (P=0.046). OS, overall survival; KPS, Karnofsky performance scale; PNI, prognostic nutritional index; NLR, neutrophil to lymphocyte ratio.

blood samples were collected varied considerably among the different studies: in Zhang *et al.*'s study, peripheral blood samples were collected within the week preceding treatment, and Cao *et al.* (34) and Khunger *et al.* (32) implied that there was a significant correlation between NLR and OS after treatment.

However, to precisely determine the effects of immunonutrition status and inflammatory state on tumor prognosis and therapeutic efficacy, further large-scale prospective clinical studies are needed to address the following concerns: (I) determining a unified best cut-off value; (II) the influence of the dynamic changes of the indicators on the curative effect; (III) determining a unified application of a combination of conventional serum biomarkers for accurately predicting treatment response; (IV) evaluating of the effects of intervening predictive indicators for improving the survival of patients.

This study has several limitations. Firstly, this was a retrospective, single-center study with small sample size. Secondly, PNI and NLR data were collected within the 1-week preceding treatment, and fluctuations in PNI and NLR throughout the entire treatment procedure and follow-up were not fully recorded and analyzed. This is noteworthy because these data may change according to time and conditions during treatment. Thirdly, many other biologic markers were not included in the evaluation due to the lack of data on the side effects of chemotherapy. Therefore, further large, multicenter studies are warranted to explicitly determine the effectiveness and accuracy of PNI and NLR for predicting the prognosis of advanced NSCLC patients treated with platinum-based chemotherapy. The heterogeneity of the subjects included in our study is high,

Table 4 Univariate and multivariate analyses of overall survival in the advanced NSCLC patients

Variables	n	MST (months)	Univariate			Multivariate			
			95% CI	χ^2	P value	RR	95% CI	χ^2	P value
Age (years)				0.021	0.883	–	–	–	–
≥60	74	15.772	11.862–19.683						
<60	25	15.480	10.363–20.597						
Gender				1.176	0.278	–	–	–	–
Male	66	14.603	10.904–18.301						
Female	33	16.280	12.593–19.966						
Smoking history				3.334	0.068	–	–	–	–
Smoker	53	13.622	9.651–17.593						
Non-smoker	46	16.893	13.767–20.019						
KPS score				8.670	0.003	1.444	0.800–2.608	1.486	0.223
≥70	77	17.227	13.608–20.847						
<70	22	9.323	6.347–12.300						
Histological type				3.478	0.062	–	–	–	–
Squamous	45	12.263	9.463–15.063						
Adenocarcinoma	54	17.736	13.357–22.116						
Tumor differentiation				10.631	0.001	0.611	0.373–1.000	3.841	0.050
Poorly differentiated	43	10.824	8.960–12.688						
Moderately-well differentiated	56	18.784	14.073–23.496						
Brain metastasis				17.922	<0.001	3.683	1.548–8.764	8.690	0.003
With brain metastasis	8	5.625	3.226–8.024						
Without brain metastasis	91	16.475	13.287–19.664						
Chemotherapy regimen				0.670	0.413				
With cisplatin	51	14.572	10.416–18.728						
With carboplatin	48	16.264	12.523–20.004						
PNI				12.966	<0.001	1.745	1.062–2.866	4.837	0.028
≥52.525	45	20.457	15.257–25.656						
<52.525	54	10.816	8.475–13.157						
NLR				3.973	0.046	1.357	0.833–2.211	1.499	0.221
≥3.535	40	11.951	9.178–14.724						
<3.535	59	17.954	13.410–22.498						

NSCLC, non-small cell lung cancer; MST, mean survival time; KPS, Karnofsky performance scale; PNI, prognostic nutrition index; NLR, neutrophil to lymphocyte ratio; CI, confidence interval; RR, relative risk.

so one of the subgroups, such as patients with EGFR mutation, can be selected for analysis in the next study. Prospective studies could also be designed to assess more aggressive treatment of patients with a perceived poor prognosis.

Conclusions

PNI is a reliable, simple, easily available, and inexpensive biomarker for predicting the prognosis of advanced NSCLC patients treated with platinum-based chemotherapeutics in routine clinical practice. Furthermore, a high PNI value may serve as an independent predictor of long-term OS. PNI is a superior prognostic indicator to NLR for determining the prognosis of advanced NSCLC patients treated with platinum-based chemotherapeutics.

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Footnote

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