Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2025.415019.4119 Volume 31, Issue 11 November. 2025
Manuscript ID:ZUMJ-2508-4119
DOI:10.21608/zumj.2025.415019.4119

ORIGINAL ARTICLE

Prognostic Value of Nutritional Index in Patients with Diffuse large B Cell Lymphoma

Mohamed Gamal El-Shamy [1], Ayman Fathy Abd El-Halim [1], Kholoud Mohamed Hassan [1], Elsayed Anany Metwally [1]

[1] Internal Medicine - Clinical Hematology Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt.

***Corresponding author:**
Kholoud Mohamed Hassan

Email:
dockhokha123@gmail.com

Submit Date 17-08-2025
Revise Date 17-09-2025
Accept Date 20-09-2025

ABSTRACT

Background: Diffuse large B-cell lymphoma (DLBCL) is the most common subtype of non-Hodgkin Lymphoma in adults, characterized by a wide range of clinical features and prognoses. The Prognostic Nutritional Index (PNI), which combines immunological and nutritional factors, has demonstrated prognostic value in various cancers; however, its role in DLBCL remains unclear. This study aimed to evaluate the contribution of PNI to the early outcome prediction of patients with DLBCL.

Methods*:* This prospective cohort study included 50 adult patients with histologically confirmed DLBCL who were treated with standard R-CHOP at the Hematology Unit, Internal Medicine Department, Zagazig University Hospitals. Associations between PNI and clinicopathological features, treatment response, and survival were assessed.

Results*:* The mean PNI was 30.93 ± 5.81 (range: 23–43). Higher PNI values correlated positively with hemoglobin, platelet count, MPV, and L/M ratio, and negatively with TLC, ANC, AMC, N/L ratio, and CRP ($p < 0.05$). Patients with higher PNI showed significantly higher complete remission (CR) rates after 4 and 6–8 cycles ($p < 0.05$). ROC curve analysis identified optimal PNI cut-offs for predicting CR (≥30.0068; AUC = 0.757) and mortality (≤30.011; AUC = 0.700). In multivariate analysis, male sex, elevated TLC, and suboptimal response (PR or NR) independently predicted poorer survival, while low PNI showed a non-significant trend toward adverse outcomes.

Conclusion: PNI is a simple, cost-effective biomarker that reflects both immunological and nutritional status, with strong predictive value for treatment response and mortality in DLBCL. Incorporating PNI into baseline assessments may enhance early risk stratification and support personalized treatment strategies.

Key words: Diffuse large B-cell lymphoma; Prognostic Nutritional Index; Nutritional status

INTRODUCTION

In Western countries, 31% of all NHL cases are diffuse large B-cell lymphoma (DLBCL), the most common lymphoid cancer in adults. According to current estimates, there are 15–20 incidences of non-Hodgkin's lymphoma (NHL) per 100,000 people in the USA and Europe per year [1]. According to data from the WHO Classification of Tumours of Hematopoietic and Lymphoid Tissues, Fourth Edition Mjali et al. [2], and the Non-Hodgkin's Lymphoma Classification Project (International NHL Study Group, 1997), DLBCL accounts for about 31% of all NHL cases in Western countries [3].

The division of DLBCLs into distinct clinical entities, molecular and immunophenotypic groups, and morphological variants has been made possible by further morphological, biological, and clinical investigations. DLBCL, not otherwise specified (NOS), is the collective designation for the majority of cases that remain biologically and clinically diverse and lack well-defined and recognized subclassification criteria. With the seventh decade as the median age, DLBCL-NOS

primarily affects adults, although it can sometimes occur in younger individuals. Prognosis, behavior, and clinical presentation are largely determined by the extranodal site present at onset. About 20% of patients have localized disease at presentation. One-third of patients exhibit systemic symptoms, while disseminated extranodal disease is less common. Overall, DLBCLs are aggressive but potentially treatable cancers [4].

The International Prognostic Index (IPI) and the revised IPI (R-IPI) are used to evaluate the prognosis of diffuse large B-cell lymphoma (DLBCL). We evaluated the correlation between the Prognostic Nutritional Index (PNI) and the clinical features of diffuse large B-cell lymphoma (DLBCL). PNI was calculated as 10 × serum albumin level (g/dL) + 0.005 × absolute lymphocyte count (/mm³). Since the introduction of rituximab, a monoclonal antibody, the survival rate of DLBCL has significantly increased [5].

The Prognostic Nutritional Index (PNI) is an essential tool in oncology for determining a patient's immunonutritional status. Initially developed for gastrointestinal cancer, it is now used to predict immune competence, nutritional depletion, and systemic inflammation. Its components peripheral lymphocyte count and serum albumin concentration reflect both immune and nutritional status, which are critical for cancer prognosis [6].

According to recent research, there is a strong correlation between PNI and the clinical outcomes of individuals with diffuse large B-cell lymphoma (DLBCL). Unfavorable disease characteristics, such as advanced stage at presentation, elevated lactate dehydrogenase (LDH), poor performance status, and higher IPI scores, have all been associated with lower PNI values. Moreover, even in patients receiving rituximab-based chemoimmunotherapy for DLBCL, PNI has been shown to be an independent predictor of progression-free survival (PFS) as well as overall survival (OS) [7].

METHODS

Study Design and Ethical Approval

Between January 2024 and January 2025, 48 patients with diffuse large B-cell lymphoma (DLBCL) confirmed by histology were selected from the Internal Medicine Department's Hematology Unit at Zagazig University Hospitals to participate in this prospective cohort study. Eligible participants were adults above the age of 18 years of both genders, diagnosed according to the WHO classification Swerdlow et al. [8], and treated with the standard R-CHOP regimen. Patients were excluded if they had active infections, positive serologic tests for human immunodeficiency virus, were pregnant, or declined to provide informed consent and cooperate with the study protocol. Prior to recruitment, Written informed consent was provided by each patient. The Board for Institutional Review, Zagazig University Hospitals, and the Internal Medicine Department gave their approval to the study. (IRB#11338-23-1-2024). The Declaration of Helsinki and its revisions' ethical guidelines were followed in all research procedures.

Sample Size:

A priori sample size calculation was conducted to compare two independent proportions, assuming that the low-PNI group and the high-PNI group had a frequency of B symptoms of 44% and 85.7%, respectively. 48 patients were determined to be the necessary sample size using OpenEpi, has 80% statistical power and a 95% two-sided confidence level. This figure was selected for the current inquiry.

A comprehensive evaluation was performed for all participants, including detailed medical history covering demographic data, special habits, comorbidities, and medication use, followed by a complete clinical examination. Vital indicators including blood pressure and pulse rate were noted, the latter measured using a mercury sphygmomanometer in the recumbent position, and body mass index (BMI) was calculated. General physical examination findings were documented according to standard protocols.

Laboratory investigations were performed on fasting peripheral venous blood samples (10 mL) obtained under aseptic conditions. These included serum electrolytes, tests for liver function (serum albumin, total protein, bilirubin, AST, ALT), renal function (serum creatinine and urea), Vital indicators including blood pressure and pulse rate were noted. Histological confirmation by lymph node

biopsy, and complete blood count (CBC) as determined by automated counters. The radiological examinations included computed tomography (CT) or positron emission tomography-computed tomography (PET/CT) scans. The following formula was used to calculate the prognosis nutritional index (PNI) prior to treatment initiation: PNI is equal to 0.005 × total lymphocyte count (/mm2) plus 10 × serum albumin (g/dL), as explained by Huang et al. [9].

Treatment:

In this study, all patients received first-line treatment with the R-CHOP regimen, which consisted of rituximab combined with cyclophosphamide, doxorubicin, vincristine, and prednisone [10]. According to clinical guidelines, patients with recurrent or refractory disease were evaluated for eligibility for autologous stem cell transplantation (ASCT). Regimens such as ICE (ifosfamide, carboplatin, etoposide), GDP (gemcitabine, dexamethasone, cisplatin, or carboplatin), or DHAP (dexamethasone, high dose cytarabine, cisplatin), with or without rituximab, were used to treat patients who were eligible for ASCT [11]. Those ineligible for ASCT received alternatives including GemOx (gemcitabine, oxaliplatin) with or without rituximab, polatuzumab vedotin in combination with rituximab and/or bendamustine, or other targeted regimens [12]. Treatment modifications were made for special subgroups: elderly or frail patients were prescribed less intensive therapies, patients with double-hit or triple-hit lymphoma were considered for intensive salvage regimens and early CAR T-cell therapy referral, High-dose methotrexate-based procedures, either with or without intrathecal treatment, were used to treat CNS recurrence, and individuals with prior platinum intolerance received gemcitabine/oxaliplatin or novel antibody-based agents[13].

Outcome:

Following the conclusion of the induction phase, the response to treatment was evaluated, which lasted four months, with evaluation of PNI prior to treatment to determine its prognostic significance for therapeutic response and survival outcomes. Disease-free survival (DFS) was defined as the interval between obtaining a treatment response and recurrence or death, whereas overall survival (OS) was calculated from the date of diagnosis to the date of death from any cause. In order to track disease status and survival results, following the completion of induction therapy, patients were observed every two months after that.

Statistical analysis:

All the data was collected, organized, and analyzed using SPSS software version 24.0 for Windows (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test was used to assess the normality of the data distribution. The qualitative variables were summarized using frequencies and relative percentages, and groups were compared using the Chi-square (χ^2) test or Fisher's exact test, if appropriate. Quantitative variables were expressed using the median with range for non-normally distributed data and the mean ± standard deviation (SD) for normally distributed data. Two groups were compared using the Mann-Whitney U test for non-parametric variables and the independent t-test for parametric variables. The study employed stepwise regression analysis to identify independent outcome predictors. Survival curves were compared using the log-rank test, and event-free survival was estimated using the Kaplan-Meier technique. A p-value of less than 0.05 was considered to be statistically significant. Receiver operating characteristic (ROC) curves were analyzed in order to compare different diagnosis or prognostic models and find the best cutoff values. By comparing observations from the same cases under the normal distribution and correcting for correlation, the Cantor technique was used to calculate AUC, or area under the ROC curve and its standard error. The following was the interpretation of the AUC: 0.90 to 1.00 is excellent; 0.80 to 0.90 is good; 0.70 to 0.80 is decent; 0.60 to 0.70 is low; and 0.50 to 0.60 is fail. The value that corresponded to the highest diagnostic accuracy was determined to be the ideal cutoff point. Every statistical test was two-tailed, additionally, a difference was considered statistically significant if $p \leq 0.05$, non-significant if $p > 0.05$, and highly significant if $p < 0.001$.

RESULTS

The current investigation comprised 50 patients were diagnosed with DLBCL or diffuse large B-cell lymphoma. Females represented 42% of the cohort, with 60% of patients aged below 60 years, 28% being smokers, and table 1 indicates that 52% have a performance status (PS) of 2. Regarding clinical characteristics (Table 1), 78% of patients presented with B symptoms, 28% had bulky disease, 22% had diabetes, 14% had hypertension, and 54% were classified as Ann Arbor stage IV. High-risk disease according to IPI was present in 38% of patients.

Table 2; Mean serum albumin, hemoglobin and MPV are 3.09 g/dl, 11.41 g/dl, and 9.2 respectively. Median TLC and platelet count were 6.3 and 147.5 (10^3/mm^3) respectively. Median L/M ratio and N/L ratio were 3.8 and 3.33 respectively. PNI ranged from 23 to 43 with mean 30.93. PNI is positively correlated with hemoglobin, platelet count, MPV, and L/M ratio in a statistically significant way. All of TLC, ANC, AMC, ALC, N/L ratio, and CRP had statistically significant negative correlations with PNI.

A statistically significant correlation was shown in Table 3 between PNI and treatment response with 1st line R-CHOP Regimen at cycles 4 and 6–8. After three cycles, there is a substantial difference between CR and PR in terms of therapy response, according to the post hoc test. After 6–8 cycles, the CR and other groups' responses to therapy differ significantly, according to the post hoc test. Statistical significance is indicated by an area under the curve (AUC) CI CR clinical remission confidence interval of *$p<0.05$ and **$p\leq0.001$. With an area under the curve of 0.757 (95% CI: 0.614 – 0.899), 75% sensitivity, and 70% specificity (p=0.002), the ideal PNI threshold for CR prediction after three cycles is ≥30.0068 (Figure 1a).

According to table 4, after four cycles of receiving ttt with R-CHOP Regimen, 40% had CR, 24% had NR and 36% had PR. After 6 to 8 cycles; 36% had CR, 49% had NR and 16% had PR. Twenty-three were non-survivors (46%). Overall survival ranged from 307 to 1460 days with median 701 days.

Table 5 demonstrated a statistically significant correlation between mortality and PNI. Lower PNI significantly associated with mortality.

Table 6; showed the best cutoff of PNI in prediction of mortality is ≥30.011, Sensitivity was 91.3%, specificity was 55.6%, and area under the curve was 0.7 (95% CI: 0.551–0.849) (p=0.016) as shown in figure 2.

Male gender, higher TLC, PR after 4 cycles and NR after 6-8 cycles significantly increase hazard ratio by 4.18, 1.01, 4.04 and 5.59 folds respectively. PNI≤30.011 non-significantly increases hazard ratio by 3.02 folds. On doing multivariate cox regression analysis, male sex, higher TLC, L/M ratio, N/L ratio, PNI≤30.011, NR and PR after 4 cycles, NR and PR after 6-8 cycles independently increased risk by 4.55, 1.01, 1.0, 1.04, 1.2, 2.99, 2.45, 3.25 and 2.39 folds respectively as shown in table 7.

Table 1: Baseline demographic and clinical characteristics:

	N=50	%
demographic data		
Sex:		
Female	**21**	**42%**
Male	**29**	**58%**
Age:		
<60 years	**30**	**60%**
>60 years	**20**	**40%**
Smoking		
No	**36**	**72%**
Yes	**14**	**28%**
PS		
1	**7**	**14%**
2	**26**	**52%**
3	**16**	**32%**

	N=50	%
4	1	2%
Clinical symptoms		
Presentation B symptoms	39	78%
Bulky disease No Yes	 36 14	 72% 28%
Comorbidities Diabetes Hypertension CLD COPD Positive HCV	 11 7 2 0 5	 22% 14% 4% 0% 10%
Ann arbor stage I II III IV	 3 16 4 27	 6% 32% 8% 54%
Extra-nodal lymph node 0 1 2 3	 27 19 3 1	 54% 38% 6% 2%
IPI Low risk Low intermediate High intermediate High risk	 16 4 11 19	 32% 8% 22% 38%
NCCN IPI 1 2 3 4 5 6	 2 14 10 16 5 3	 4% 28% 20% 32% 10% 6%

Table 2: Distribution of Studied Patients and Correlation Between PNI and Laboratory & Disease-Specific Data:

	Mean ± SD/ median (IQR)	Range
Distribution of studied patients		
Serum albumin (g/dl)	3.09 ± 0.58	2.3 – 4.3
Hemoglobin (g/dl)	11.41 ± 1.43	8 – 14
TLC (10^3/mm^3)	6.3(5.3 – 10)	4.3 – 508
ANC (10^3/mm^3)	3.2(2.3 – 7)	1.8 – 27,5
AMC (10^3/mm^3)	0.5(0.3 – 0.9)	0.2 – 2.7
ALC(10^3/mm^3)	1.2(0.8 – 2.13)	0.5 – 3.3
Platelet count (10^3/mm^3)	147.5(124 – 288.5)	108 – 450
MPV	9.2 ± 0.99	7.5 – 11
L/M ratio	3.8(0.8 – 6.53)	0.29 – 12
N/L ratio	3.33(1.25 – 7.93)	0.6 – 34.3
CRP	60(23.75 – 128.75)	10 – 320

	Mean ± SD/ median (IQR)	Range
LDH	**435(269 – 597.75)**	**208 – 2128**
PNI	**30.93 ± 5.81**	**23.0 – 43.0**
Correlation between PNI and laboratory and disease-specific data		
	r	**p**
Hemoglobin (g/dl)	**0.304**	**0.032***
TLC (10^3/mm^3)	**-0.587**	**<0.001****
ANC (10^3/mm^3)	**-0.608**	**<0.001****
AMC (10^3/mm^3)	**-0.583**	**<0.001****
Platelet count (10^3/mm^3)	**0.775**	**<0.001****
MPV	**0.567**	**<0.001****
L/M ratio	**0.68**	**<0.001****
N/L ratio	**-0.679**	**<0.001****
CRP	**-0.578**	**<0.001****
LDH	**-0.174**	**0.227**
EF (%)	**0.213**	**0.137**
PS	**0.235**	**0.1**
Ann Arbor stage	**-0.08**	**0.503**
Extra-nodal	**0.007**	**0.963**
IPI	**0.144**	**0.317**
NCCN IPI	**-0.059**	**0.686**

r Spearman rank correlation coefficient *p<0.05 is statistically significant
**p≤0.001 is statistically highly significant

Table 3: Relation between PNI and response to therapy of studied patients:

	Mean ± SD	F	p	Posthoc
At 4 cycles:				
CR	**34.11 ± 5.9**			**P_1 0.057**
NR	**29.42 ± 6.32**	**6.2**	**0.004***	**P_2 >0.999**
PR	**28.39 ± 3.48**			**P_3 0.005***
At 6-8 cycles:				
CR	**36.01 ± 4.37**			**P_1 <0.001****
NR	**27.09 ± 2.36**	**23.052**	**<0.001****	**P_2 0.082**
PR	**31.01 ± 7.39**			**P_3 0.022***

F One way ANOVA test *p<0.05 is statistically significant **p≤0.001 is statistically highly significant p1 difference between CR and NR p2 difference between NR and PR p3 difference between CR and PR

Table 4: Distribution of studied patients according to outcome:

	N=50	%
At 4 cycles:		
CR	**20**	**40%**
NR	**12**	**24%**
PR	**18**	**36%**
At 6-8 cycles:		
CR	**18**	**36%**
NR	**24**	**48%**
PR	**8**	**16%**
Death:		
Survivors	**27**	**54%**
Non-survivors	**23**	**46%**
	Median (IQR)	**Range**
Overall survival (day)	**701(471 – 905.25)**	**307 – 1460**

Table (5) Relation between PNI and outcome of studied patients:

	Mean ± SD	t	p
Death **Non-survivors** **Survivors**	**33.08 ± 6.09** **28.4 ± 4.35**	**3.161**	**0.003***

t independent sample t test

Table (6) Performance of PNI in prediction of mortality:

Cutoff	AUC	95% CI	Sensitivity	Specificity	p
≤30.011	0.7	0.551 – 0.849	91.3%	55.6%	0.016*

Area under the curve (AUC) CI **p≤0.001 is statistically very significant, and *p<0.05 is statistically significant for the CR clinical remission confidence interval.

Table (7): Univariate and multivariate analysis of predictors of overall survival:

	CHR (95% CI)	p	AHR (95% CI)	p
Male sex	**4.18(1.56 – 11.2)**	**0.005***	**4.55(1.32 – 15.69)**	**0.016***
Age>60	**1.52(0.67 – 3.47)**	**0.316**		
B symptoms	**1.74(0.52 – 5.89)**	**0.373**		
Bulky disease	**1.7(0.71 – 4.07)**	**0.23**		
TLC	**1.01(1.0 – 1.01)**	**0.005***	**1.01(1.0 – 1.01)**	**0.051**
CD-20	**23.68(0.02 – 38057.5)**	**0.401**		
CD-19	**0.72(0.21 – 2.42)**	**0.593**		
CD-3	**0.89(0.39 – 2.02)**	**0.776**		
CD-30	**0.86(0.33 – 2.24)**	**0.757**		
CD-23	**0.97(0.12 – 7.06)**	**0.942**		
L/M ratio	**0.91(0.8 – 1.03)**	**0.144**	**1.0(0.81 – 1.24)**	**0.986**
N/L ratio	**1.05(0.99 – 1.12)**	**0.116**	**1.04(0.93 – 1.17)**	**0.603**
PNI≤30.011	**3.02(0.89 – 10.23)**	**0.076**	**1.2(0.18 – 8.18)**	**0.851**
Outcome 4 cycles **CR** **NR** **PR**	 **1 (Reference)** **3.19(0.84 – 12.13)** **4.04(1.12 – 14.5)**	 **0.102** **0.089** **0.033***	 **1 (reference)** **2.99(0.64 – 13.93)** **2.45(0.52 – 11.7)**	 **0.368** **0.163** **0.26**
Outcome 6-8 cycles **CR** **NR** **PR**	 **1 (Reference)** **5.59(1.28 – 24.33)** **3.72(0.62 – 22.34)**	 **0.068** **0.022*** **0.15**	 **1 (Reference)** **3.25(0.49 – 21.51)** **2.39(0.35 – 16.59)**	 **0.461** **0.223** **0.377**

CHR crude hazard ratio AHR adjusted hazard ratio CI confidence interval *p<0.05 is statistically significant

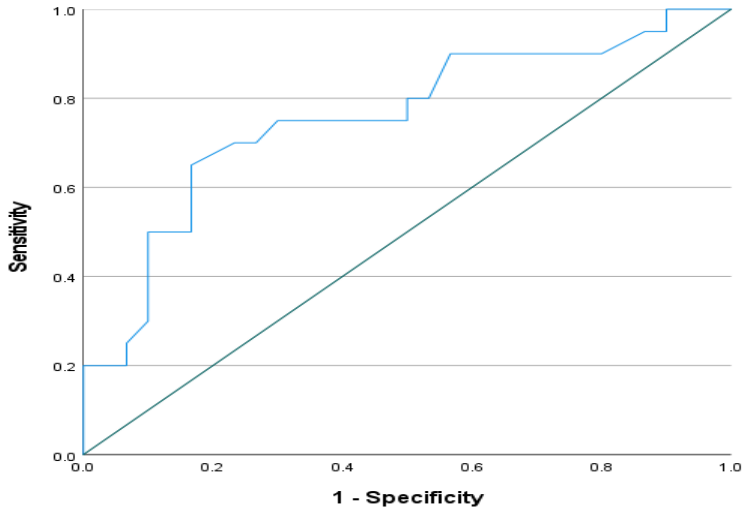

Figure (1a): ROC curve showing performance of PNI in prediction of CR after 3 cycles

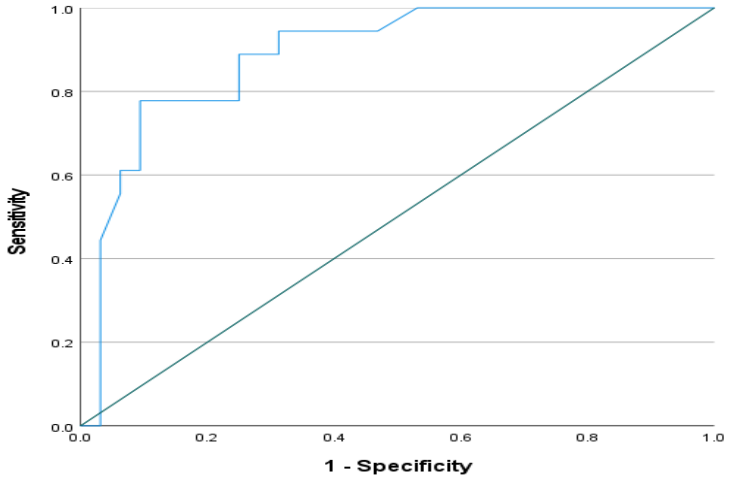

Figure (1b): ROC curve showing performance of PNI in prediction of CR after 6-8 cycles

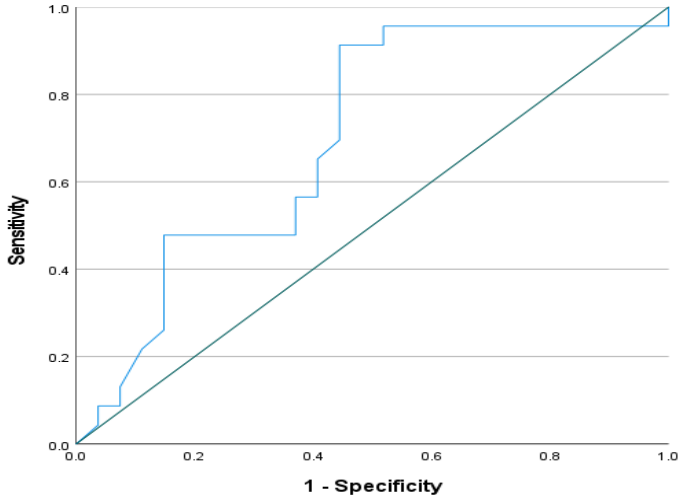

Figure (2): ROC curve showing performance of PNI in prediction of mortality

DISCUSSION

Our retrospective cohort study was conducted at hematology unit in internal medicine department, faculty of medicine Zagazig university on cases who received novel chemotherapy as R-CHOP.

In our study of 50 patients, females accounted for 42%, with the majority under 60 years of age, 60% of patients aged<60 years, 28% were smoker, and 52% of patients had PS 2. These characteristics align with previous large-scale studies, such as McMillan et al. [14], confirming the representativeness of our cohort.

Males were more likely to possess Diffuse Large B-Cell Lymphoma (DLBCL), in accordance with established epidemiological principles. Smokers made up a sizable share of the patient population. Additionally, many patients had a Performance Status of 2, indicating a notable disease burden.

In our study, thirty-nine patients had B symptoms (78%), 28% had bulky disease, 22% had comorbid diabetes, 14% had hypertension, 54% had Ann arbor stage IV, 54% had no extra-nodal extension, 38% were high risk.

Our study can be supported by Korkmaz et al. [15] who stated that over 75% of DLBCL patients have advanced stage disease, which is commonly defined as bulky disease > 10 cm or Ann Arbor stages 3 and 4 or stages 1 and 2 with associated B-symptoms (28%).

In our study, mean serum albumin, hemoglobin and MPV are 3.09 g/dl, 11.41 g/dl, and 9.2 respectively. Median TLC and platelet count were 6.3 and 147.5 (103/mm3) respectively. Median L/M ratio and N/L ratio were 3.8 and 3.33 respectively.

Our study can be reinforced by Hu et al. [16] who reported that DLBCL patients older than 70 years, those with low serum albumin (SA) levels (mean 3.41±0.42 g/dL) exhibited several adverse clinical characteristics. Hemoglobin levels were lower in this group (111.5±21.8g/L) compared to those with higher SA (P=0.013). At 4.0 (2.5, 6.2) (P=0.016), the neutrophil-to-lymphocyte ratio (NLR) was noticeably higher, suggesting increased systemic inflammation. These findings suggest that low SA levels correlate with poorer hematologic parameters, higher inflammatory markers, in elderly DLBCL patients.

The Prognostic Nutritional Index (PNI) in our study ranged from 23 to 43, with a mean of 30.93, which reflects the nutritional and immune status of the patients. A lower PNI score (around 23) may indicate malnutrition or immune suppression, both of which are associated with a poorer prognosis in cancer patients. In Diffuse Large B-Cell Lymphoma (DLBCL), malnutrition can contribute to weakened immune function, reduced treatment tolerance, and worse overall outcomes. Conversely, a higher PNI score (closer to 43) suggests better nutritional and immune status, which could correlate with improved treatment response and better survival outcomes. The mean PNI of 30.93 in our cohort suggests that, on average, the patients had suboptimal nutritional status or some degree of immune compromise, which is consistent with the advanced disease, comorbidities, and high-risk factors seen in the cohort Aras et al [17].

Provided support for our study by stating that 30–40% of cancer patients suffer from malnutrition, and that nutritional status is a critical factor in therapy responsiveness and prognosis. which leads to adverse outcomes like increased mortality and morbidity. The Prognostic Nutritional Index (PNI), a noninvasive, inexpensive, and standardized tool, has drawn interest. Research, such as that conducted by Periša et al. [19] and Ozturk et al. [20], has demonstrated that poor treatment response is linked to lower PNI scores. advanced disease stage, and worse survival outcomes in DLBCL patients. Moreover, a meta-analysis conducted by Luan et al. [21] confirmed that progression-free survival (PFS) and poor overall survival (OS) in DLBCL are predicted by low PNI. Malnutrition and immunological dysfunction are most likely the mechanisms relating low PNI to bad prognosis.

The distribution of patient outcomes after treatment cycles with R-CHOP Regimen showed varied responses. After four cycles, 40% of patients achieved complete remission (CR), 24% had no response (NR), and 36% had partial remission (PR). After six to eight cycles, the response shifted, with 36% achieving CR, 49% showing NR, and 16% achieving PR. Unfortunately, 23 patients (46%) were non-survivors. With a median survival of 701 days, the overall survival length varied between 307 and 1460 days, indicating a significant variation in treatment effectiveness and patient outcomes.

Wang et al. [22] Between April 2010 and January 2023, the study included 352 newly diagnosed patients with diffuse large B-cell lymphoma (DLBCL). 46 (14.4%) of these individuals experienced a relapse following an initial response. 39 (11.1%) had a partial response (PR), and 281 (79.8%) had complete remission (CR).

Hemoglobin, platelet count, MPV, and L/M ratio all showed statistically significant positive correlations with PNI in our study. All of TLC, ANC, AMC, ALC, N/L ratio, and CRP had statistically significant negative correlations with PNI.

The Prognostic Nutritional Index's (PNI) notable associations with various blood markers likely reflect underlying mechanisms linking nutritional status, immune function, and inflammation. Higher PNI values, which are indicative of better nutritional status and a stronger immune system, were positively correlated with improved hemoglobin levels, platelet count, MPV, and the L/M ratio. These factors suggest a better overall hematologic profile and reduced inflammation, which can enhance tissue repair and immune surveillance. On the other hand, the negative correlation between PNI and markers like TLC, ANC, AMC, ALC, N/L ratio, and CRP indicates that immunological dysregulation is linked to a lower PNI, increased inflammation, and compromised immune response. This interplay between nutrition, immune function, and inflammation helps explain the ability to forecast illness outcomes in individuals with

diseases such as diffuse large B-cell lymphoma (DLBCL) using PNI [23].

In our study patients with diffuse large B-cell lymphoma (DLBCL), inflammatory indicators such as the neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) are important prognostic variables. NLR and CRP levels have been found to significantly positively correlate, suggesting that higher inflammation is linked to more severe illness [15]. Additionally, research in the *Turkish Journal of Medical Sciences* discovered that a lower Prognostic Nutritional Index (PNI), which indicates a weakened immunological and nutritional state, is linked to poorer overall and progression-free survival[20]. Similarly, the British Journal of Cancer emphasized indicates patients with DLBCL who have higher CRP levels have worse outcomes [24]. Therefore, the correlation between NLR, CRP, and PNI in DLBCL patients emphasizes the vital role that inflammation plays and nutritional/immune status, with elevated NLR and CRP levels and low PNI being associated with poorer prognosis and reduced survival outcomes.

Furthermore, at cycles four and six to eight, there is a statistically significant correlation between PNI and response to treatment. After three cycles, there is a substantial difference between CR and PR in terms of therapy response, according to the posthoc test. After 6–8 cycles, The CR and other groups' responses to therapy differ significantly, according to the posthoc test.

In our study there is statistically significant relation between PNI and mortality. Lower PNI significantly associated with mortality. The best cutoff of PNI in prediction of mortality is ≤ 30.011, area under curve 0.7 (95% CI; 0.551 – 0.849), sensitivity 91.3% and specificity 55.6% (p=0.016). There is statistically non-significant relation between overall survival and PNI cutoff for prediction of mortality (non-significantly higher among patients with PNI > 30.011). There is statistically non-significant relation between two-year overall survival and PNI cutoff for prediction of mortality (non-significantly higher among patients with PNI>30.011).

Luan et al. [21] according to a meta-analysis published in Cancer Cell International, a low PNI is a significant predictor of poor overall survival and progression-free survival in patients with DLBCL.

In our study Male gender, higher TLC, PR after 4 cycles and NR after 6-8 cycles significantly increase hazard ratio by 4.18, 1.01, 4.04 and 5.59 folds respectively. PNI≤30.011 non-significantly increases hazard ratio by 3.02 folds. On doing multivariate cox regression analysis, male sex, higher TLC, L/M ratio, N/L ratio, PNI≤30.011, NR and PR after 4 cycles, NR and PR after 6- 8 cycles independently increased risk by 4.55, 1.01, 1.0, 1.04, 1.2, 2.99, 2.45, 3.25 and 2.39 folds respectively.

CONCLUSION

This study highlights the Prognostic Nutritional Index (PNI) as a valuable predictor of early death, treatment responsiveness, and overall survival in patients with diffuse large B-cell lymphoma (DLBCL). Poorer outcomes, such as lower rates of full remission, increased mortality, and worse overall survival, were substantially correlated with lower PNI levels. Our results highlight how crucial it is to include immunological and nutritional status in prognostic evaluations for DLBCL, with PNI acting as a possible instrument for patient risk stratification. In order to enhance therapeutic outcomes, our findings lend credence to the necessity of early intervention and individualized treatment plans, especially for patients with low PNI.

Authors' contributions:

In addition to writing and getting the book ready for publication, the writers were in charge of gathering and analyzing the data. The final version was examined and approved by all authors.

Conflict of Interest: No potential conflict of interest relevant to this article was reported. The authors alone are responsible for the content and writing of the paper.

Funding information: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval (including reference number): The Faculty of Medicine International Review Board (IRB) and the Zagazig University Ethical Committee

approved this study (Ethics code: ZU- IRB #11338-23-1-2024).

REFERENCES

1.Kanas G, Ge W, Quek RG, Keeven K, Nersesyan K, Arnason JE. Epidemiology of diffuse large B-cell lymphoma (DLBCL) and follicular lymphoma (FL) in the United States and Western Europe: population-level projections for 2020–2025. Leuk Lymphoma. 2022;63(1):54-63.
2.Mjali A, Oudah AH, Al-Shammari HH, Abbas NT. Classification of non-Hodgkin lymphoma in the Middle Euphrates Region of Iraq according to the World Health Organization classification. Iraqi J Hematol. 2021;10(2):170-5.
3.Reedijk AM, Beishuizen A, Coebergh JWW, Hoeben BA, Kremer LC, Hebeda KM, et al. Progress against non-Hodgkin's lymphoma in children and young adolescents in the Netherlands since 1990: stable incidence, improved survival and lower mortality. Eur J Cancer. 2022;163:140-51.
4.Berhan A, Almaw A, Damtie S, Solomon Y. Diffuse large B cell lymphoma (DLBCL): epidemiology, pathophysiology, risk stratification, advancement in diagnostic approaches and prospects: narrative review. Discov Oncol. 2025;16(1):1-15.
5.Maurer MJ, Jakobsen LH, Mwangi R, Schmitz N, Farooq U, Flowers CR, et al. Relapsed/refractory international prognostic index (R/R-IPI): an international prognostic calculator for relapsed/refractory diffuse large B-cell lymphoma. Am J Hematol. 2021; 96(5):599-605.
6.Yan X, Wang J, Mao J, Wang Y, Wang X, Yang M, et al. Identification of prognostic nutritional index as a reliable prognostic indicator for advanced lung cancer patients receiving immune checkpoint inhibitors. Front Nutr. 2023;10:1213255.
7.Shen Z, Wang F, He C, Li D, Nie S, Bian Z, et al. The value of prognostic nutritional index (PNI) on newly diagnosed diffuse large B-cell lymphoma patients: a multicenter retrospective study of HHLWG based on propensity score matched analysis. J Inflamm Res. 2021; 14:5513-22.
8.Swerdlow SH, Campo E, Pileri SA, Harris NL, Stein H, Siebert R, et al. The 2016 revision of the World Health Organization classification of lymphoid neoplasms. Blood. 2016;127(20):2375-90.
9.Huang X, Hu H, Zhang W, Shao Z. Prognostic value of prognostic nutritional index and systemic immune-inflammation index in patients with osteosarcoma. J Cell Physiol. 2019;234(10):18408-14.
10.Candelaria M, Duenas A. Rituximab in combination with cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP) in diffuse large B-cell lymphoma. Ther Adv Hematol. 2021;12:2040620721989579.
11.Fuhrmann S, Nickelsen M, Hasenkamp J, Hüttmann A, Dreyling M, Kiehl M, et al. Lenalidomide in combination with rituximab, dexamethasone, high-dose ARA-C and cisplatinum as salvage therapy in refractory or relapsed aggressive B-cell non-Hodgkin-lymphoma—an open-label, multicentre phase I/II study (DSHNHL-R6). Ann Hematol. 2025; 1-9.
12.Assi R, Masri N, Dalle IA, El-Cheikh J, Ghanem H, Bazarbachi A. Polatuzumab vedotin: current role and future applications in the treatment of patients with diffuse large B-cell lymphoma. Clin Hematol Int. 2021;3(1):21-6.
13.Stegemann M, Denker S, Schmitt CA. DLBCL 1L—what to expect beyond R-CHOP? Cancers (Basel). 2022;14(6):1453.
14.McMillan A, Phillips E, Kirkwood A, Barrans S, Burton C, Rule S, et al. Favourable outcomes for high-risk diffuse large B-cell lymphoma (IPI 3–5) treated with front-line R-CODOX-M/R-IVAC chemotherapy: results of a phase 2 UK NCRI trial. Ann Oncol. 2020;31(9):1251-9.
15.Korkmaz İ, Peri B, Karaali R. Assessment of systemic immune-inflammatory index and other inflammatory parameters in predicting mortality in patients with acute cholecystitis: a retrospective observational study. J Acute Dis. 2024;13(4):150-6.
16.Hu X, Feng X, Wang H, Miao Y, Lian X, Gao Q, et al. Association between serum albumin levels and survival in elderly patients with diffuse large B-cell lymphoma: a single-center retrospective study. Transl Cancer Res. 2023; 12(6):1577.
17.Aras MR, Yilmaz F, Tiglioglu M, Saglam B, Yuzgenc B, Ozturk HBA, et al. The prognostic significance of prognostic nutritional index in diffuse large B cell lymphoma patients. Int J Hematol Oncol. 2023;33(1):8-13.
18.Periša V, Zibar L, Knezović A, Periša I, Sinčić-Petričević J, Aurer I. Prognostic nutritional index as a predictor of prognosis in patients with diffuse large B cell lymphoma. Wien Klin Wochenschr. 2017;129:411-9.
19.Ozturk E, Elibol T, Kilicaslan E, Kabayuka B, Ozunal IE. Prognostic nutritional index predicts early mortality in diffuse large B-cell lymphoma. Medeniyet Med J. 2022;37(1):
20.Luan C, Wang F, Wei N, Chen B. Prognostic nutritional index and the prognosis of diffuse large B-cell lymphoma: a meta-analysis. Cancer Cell Int. 2020;20:1-8.
21.Wang Z, Bao Y, Xu Z, Sun Y, Yan X, Sheng L, et al. A novel inflammatory-nutritional prognostic scoring system for patients with diffuse large B cell lymphoma. J Inflamm Res. 2024; 1-13.

22.Ma S, Zhang B, Lu T, Li D, Li T, Shen Z, et al. Value of the prognostic nutritional index (PNI) in patients with newly diagnosed, CD5-positive diffuse large B-cell lymphoma: a multicenter retrospective study of the Huaihai Lymphoma Working Group. Cancer. 2022;128(19):3487-94.
23.Tuncel ET, Parvizi M, Kut E, Aydın M, Kasap E. Prognostic significance of hemoglobin/prognostic nutritional index and hemoglobin/red blood cell distribution in rectal cancer. Turk J Gastroenterol. 2023;34(2):128.
24.He L, Teng Y, Jin B, Zhao M, Yu P, Hu X, et al. Initial partial response and stable disease according to RECIST indicate similar survival for chemotherapeutical patients with advanced non-small cell lung cancer. BMC Cancer. 2010;10(1):681.

Citation

El-Shamy, M., Abd El-Halim, A., Hassan, K., Metwally, E. Prognostic Value of Nutritional Index in Patients with Diffuse large B Cell Lymphoma. ***Zagazig University Medical Journal*****, 2025; (5408-5419): -. doi: 10.21608/zumj.2025.415019.4119**