Original Article

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Prognostic effect of systemic inflammation in patients undergoing cytoreductive surgery and hyperthermic intrathoracic chemotherapy

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Abstract

Background: To investigate prognostic significance of systemic inflammation-related parameters in patients undergoing cytoreductive surgery and hyperthermic intrathoracic chemotherapy for malignant pleural mesothelioma (MPM).

Methods: Data from 55 patients were analyzed retrospectively. Demographic characteristics, survival outcomes and inflammation-related parameters (neutrophil/lymphocyte ratio [NLR], platelet/lymphocyte ratio [PLR], lymphocyte/monocyte ratio [LMR] and pan-immune inflammation value [PIV]) were evaluated.

Results: Overall survival (OS) was 61.26±13.03 (3-79) months in patients with low NLR, whereas, it was 23.18±3.53 (1-147) months in patients with high NLR (p=0.012). No statistically significant differences in OS were detected according to LMR, PLR and PIV. In addition, OS was 24.40±4.91 (3-92) months in men and 52.8±10.92 (1-147) months in women (p=0.031).

Conclusion: In this study, NLR was found to be associated with survival in agreement with the existing literature, thereby distinguishing it from other inflammatory markers as a prognostic factor. In clinical practice, predicting patient prognosis based on pre-treatment NLR may provide a valuable guidance for treatment decision-making.

Keywords: Systemic inflammation, pleural mesothelioma, prognosis, cytoreductive surgery, HITHOC.

Malignant pleural mesothelioma (MPM) is a terminal disease with a poor prognosis. Although it is the most common malignant neoplasm of the pleura, it remains an extremely rare disease (1.3/100000 per year in men, 0.2/100000 per year in women). Two well-established etiological factors of MPM are asbestos derivatives and erionite, each of which is a mineral fiber.[1,2]

Currently, a multimodal treatment approach is applied to patients with primary and secondary malignant pleural tumors. Hyperthermic intrathoracic chemotherapy (HITHOC) is usually added to macroscopic full cytoreductive surgery (pleurectomy/decortication or extrapleural pneumonectomy). The chemotherapeutic agent used for HITHOC is cisplatin, and this combined treatment is defined as a superior potential curative treatment compared to radiotherapy (RT)-chemotherapy (CT) options.[3,4] The aim of cytoreductive surgery+HITHOC is to reduce tumor burden, prolong survival and increase quality of life.[5] However, although disease is usually limited to pleural area at the time of diagnosis, survival is quite short.

With the growing number of studies in recent years, cancer has been recognised as being associated with chronic inflammation, which is influenced by numerous environmental causes and risk factors. It has been demonstrated that the vast majority of all cancer types are linked to somatic mutations and environmental factors. Approximately 20% of cancers including tumor angiogenesis, progression, invasion and metastasis, was found to be related to chronic infections, 30% to tobacco smoking and inhaled carcinogenic substances (such as silica and asbestos), and 35% to nutritional factors. Additionally, recent studies have found that there is a close relationship between systemic inflammation and factors that cause tumor genesis.[6,7]

Neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR), lymphocyte/monocyte ratio (LMR) and pan-immune inflammation value

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(PIV) are among indices widely used today reflect systemic inflammation. There are studies investigating relationships between systemic inflammation detected by NLR and prognosis in MPM. In a series of 155 patients, Abakay et al.[8] found that mortality rate of patients with MPM with high NLR values was higher than those with low NLR values. Again, in a meta-analysis in which data of 1.533 patients and 11 studies were analyzed, it was found that high NLR was associated with a poor overall survival (OS).[9]

The aim of this study is to investigate prognostic importance of systemic inflammation-related parameters (NLR, PLR, LMR, PIV) in patients undergoing cytoreductive surgery and HITHOC.

Methods

Data from 85 patients who underwent cytoreductive surgery and HITHOC for MPM between September 2008 and December 2022 were analyzed retrospectively. Patients with sarcomatoid histology, patients who received induction therapy such as RT, CT or immunotherapy in the preoperative period, patients with a different postoperative CT protocol (routine firstline protocol: Cisplatin and pemetrexed, second-line: gemcitabine) and patients with conditions affecting inflammatory processes were excluded to ensure cohort homogeneity and the study was conducted with the remaining 55 patients.

Cytoreductive surgery and HITHOC was performed on patients with adequate cardiac and pulmonary functions, good Eastern Cooperative Oncology Group/World Health Organization (ECOG) performance status (ECOG ≤2), normal blood count, and normal liver and kidney function tests. Patients with local invasion findings (such as mediastinal pleura, vertebra, mediastinal vascular involvement), distant metastasis findings, patients who were observed to have invasion of important anatomical structures during intraoperative exposure and who underwent partial resection of diaphragm and pericardium or extrapleural pneumonectomy were not considered suitable for HITHOC.

Demographic data, survival times and inflammation-related parameters of patients (NLR, PLR, LMR, PIV calculated from the blood count obtained the day before surgery) were examined (PIV was calculated according to formula = (neutrophil count × platelet count × monocyte count)/(lymphocyte count). In addition, results of histopathological examination, length of hospital stay, and complications that developed were recorded.

Surgical Procedure

Patients underwent routine posterolateral thoracotomy at through the fifth intercostal space. Extrapleural dissection was continued until the hilar structures were freed between the chest wall, diaphragm and mediastinum on one side and the parietal pleura on the other side. Following completion of cytoreductive surgery, the HITHOC procedure was performed. For this purpose, an inlet catheter was placed in the patient's thoracic cavity anteriorly and towards to the apex. An outlet catheter reaching the posterior and diaphragmatic sinus was placed to ensure fluid outflow during perfusion, and a heat sensor was placed in both catheters. The outlet catheters were reconnected to the main system via connecting tubes containing blood transfusion filters. After the closure of thoracotomy, the reservoir containing the chemotherapeutic agents was connected to the pump system after passing through the heat exchanger. In this way, the chemotherapeutic drug (cisplatin dosed at 100 mg/m^2) was perfused into the intrathoracic space between 40 °C and 42 °C at a rate of 1 liter/minute for 60 minutes.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows (version 26.0; IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation or as median (minimum-maximum), depending on data distribution, while categorical variables were expressed as numbers and percentages. The distribution of continuous variables was assessed using the Shapiro-Wilk and Kolmogorov-Smirnov tests. For normally distributed variables, comparisons between two groups were performed using the independent samples t-test. When normality assumptions were not met, the Mann-Whitney U test was used as a non-parametric alternative. Categorical variables were compared using the chi-square test. Receiver operating characteristic (ROC) curve analysis was conducted to evaluate the prognostic performance of systemic inflammatory markers, including NLR, LMR, PLR, and PIV, and to determine optimal cut-off values. Although ROC analyses were performed, statistically reliable cohort-specific threshold values could not be obtained. Due to the limited sample size and the evaluation of time-dependent outcomes such as survival, it was considered that internal threshold determination methods such as the Youden index might carry a risk of overfitting. Therefore, threshold values commonly used in the literature were preferred. OS was analyzed using the Kaplan-Meier method, and differences between groups were assessed with the log-rank test. Multivariate regression analysis with Cox's method was performed to determine independent prognostic rates, and these were evaluated using 95% confidence intervals (CIs). A p-value <0.05 was considered statistically significant.

Ethical Statement

The study was conducted in accordance with the principles of the Declaration of Helsinki. Approval was obtained from the Local Ethics Committee of Ege University for the study, which was designed as a retrospective study (approval no: 22-2T/44, date: 08.02.2024). A written informed consent was obtained from each patient.

Results

The mean age of the 55 patients included in study was 58.67±9.15 (38-81) years and 27 (49.1%) were male. According to histological subtypes, 50 (90.9%) of the patients were epithelioid, five (9.1%) were biphasic mesothelioma, and all of them were early stage patients suitable for surgery according to International Association for the study of lung cancer 9th TNM staging system.[10] Thirty patients had at least one comorbidity (54.5%) and in 40 patients (72.7%) developed at least one complication. The mean hospital stay was 11.05±6.37 (4-30) days. At the time of the study, 39 of 55 patients (70.9%) had died and OS was 27.53±27.85 (1-147) months. Demographic data are summarized in Table 1.

The mean values of NLR, LMR, PLR, and PIV were 3.11±1.11 (0.79-5.96), 3.04±1.34 (1.44-7.59), 212.06±98.76 (73.96-505.26), and 669.43±540.32 (84.08-2598.97), respectively. ROC curve analyses were performed to assess the prognostic performance of NLR, LMR, PLR, and PIV. However,

the area under the curve (AUC) values were not statistically significant (AUC: 0.633, 95% CI: 0.454-0.812, p=0.124; AUC: 0.437, 95% CI: 0.263-0.610, p=0.464; AUC: 0.535, 95% CI: 0.349-0.722, p=0.684; AUC: 0.526, 95% CI: 0.352-0.699, p=0.767, respectively) (Figure 1). Therefore, no statistically significant specific cut-off values could be determined. Due to the limited sample size and the insufficient discriminatory performance of the ROC analysis, widely accepted cut-off values reported in previous studies were used for NLR, LMR, and PLR in order to enhance clinical interpretability and ensure comparability with the existing literature (NLR: 3; LMR: 3; PLR: 149 for males and 172 for females). In contrast, no standardized or universally accepted cut-off value for PIV has been defined in the literature. Previous studies have consistently reported that PIV exhibits a non-normal, skewed distribution and therefore commonly use the median value as the cut-off point. Consistent with this approach, the median PIV value of 513.92 was used as the cut-off point in our study.[11-13] According to these results, there were 30 patients (54.5%) with high preoperative NLR values, 33 patients (60%) with low LMR values, 36 patients (65.4%) with high PLR values, and 28 patients (50.9%) with high PIV values.

Table 1. Demographic characteristics

	Number (n)	%
Gender		
Male	27	50.9
Female	28	49.1
Mean age	58.67±9.15 (min: 38-max: 81)	
Histopathological diagnosis		
Epithelioid	50	90.9
Biphasic	5	9.1
Comorbidity		
None	30	54.5
Yes	25	45.5
Postoperative complication		
None	15	27.3
Yes	40	72.7
Mortality		
None	16	70.9
Yes	39	29.1
Follow-up time	27.53±27.85 (min: 1-max: 147)	
Overall survival	41.41±7.12 (min: 1-max: 147)	
Platelet count (mean)		
Preoperative Postoperative	326000,00±110045,782 282963,64±84214,225	
Neutrophil count (mean)		
Preoperative Postoperative	4886,18±1512,31 10769,45±3117,58	
Lymphocyte count (mean)		
Preoperative Postoperative	1704,91±583,80 1041,64±385,00	
Monocyte count (mean)		
Preoperative Postoperative	607,64±204,55 997,82±350,45	

Survival Analyses

The mortality rate in patients with high preoperative NLR was higher than in those with low NLR (83.3% *vs.* 56%, p=0.026). OS was 61.26±13.03 (3-79) months in patients with low NLR, while it was 23.18±3.53 (1-147) months in patients with high NLR (p=0.012) (Figure 2).

The mortality rate was higher in patients with low preoperative LMR compared to group with high LMR, but difference was not statistically significant (72.7% *vs.* 68.2%, p=0.716). OS was 39.01±9.20 (3-147) and 40.97±8.36 (1-112) months in low and high LMR group, respectively. However, the difference was not statistically significant (p=0.351).

The mortality rate was lower in patients with low preoperative PLR compared to high PLR group, but difference was not statistically significant (63.2% *vs.* 75%, p=0.358). OS was 45.19±9.62 (8-112) and 36.13±8.18 (1-147) months in group with low and high PLR, respectively.

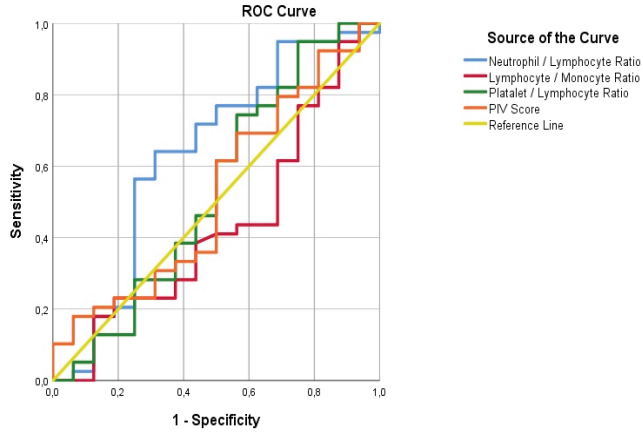

Figure 1. ROC analysis curves for NLR, LMR, PLR and PIV.

ROC: Receiver operating characteristic; NLR: Neutrophil/lymphocyte ratio; PLR: Platelet/lymphocyte ratio; LMR: Lymphocyte/monocyte ratio; PIV: Pan-immune inflammation value.

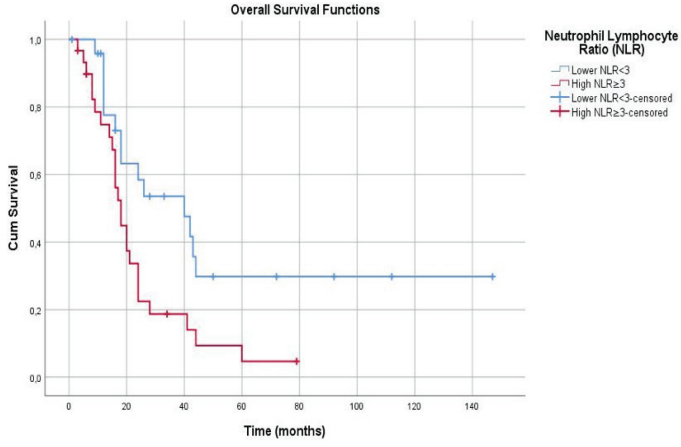

Figure 2. Survival analysis of patients according to neutrophil lymphocyte ratio.

NLR: Neutrophil/lymphocyte ratio.

However, the difference was also not statistically significant (p=0.148).

When effect of PIV on survival was analyzed, mean survival was 40.63±7.65 (3-147) and 38.28±9.88 (1-112) months in patients with low and high PIV, respectively. However, the difference was not statistically significant (p=0.370). Mortality rates in patients with low and high PIV were similar (70.4% *vs.* 71.4%). When relationship between gender and OS was examined, OS was 24.40±4.91 (3-92) and 52.8±10.92 (1-147) months in men and in women, respectively (p=0.031) (Figure 3). OS was 38.07±8.82 in patients without comorbidities and 38.19±8.39 in those with comorbidities, respectively. However, the difference was not statistically significant (p=0.647). In addition, OS was longer in those with complications, but difference was again not significant (39.21±7.79 *vs.* 33.07±6.96; p=0.621). Survival analyses are summarized in Table 2.

Given the sample size, restricting the multivariate Cox proportional hazards regression analysis to variables that were statistically significant in univariate analyses was considered more appropriate in order to reduce the risk of overfitting and to improve model stability. Accordingly, NLR and gender, which showed a significant association with OS in univariate analyses, were included in the multivariate Cox regression model.

In the multivariate Cox regression analysis, both high NLR and male gender were identified as independent prognostic factors for overall survival. Male gender was associated with a significantly increased risk of mortality (hazard ratio [HR]=2.12, 95% CI: 1.09-4.13, p=0.028), while high NLR was associated with an approximately 2.36-fold increase in mortality risk (HR=2.36, 95% CI: 1.21-4.62, p=0.012) (Table 3).

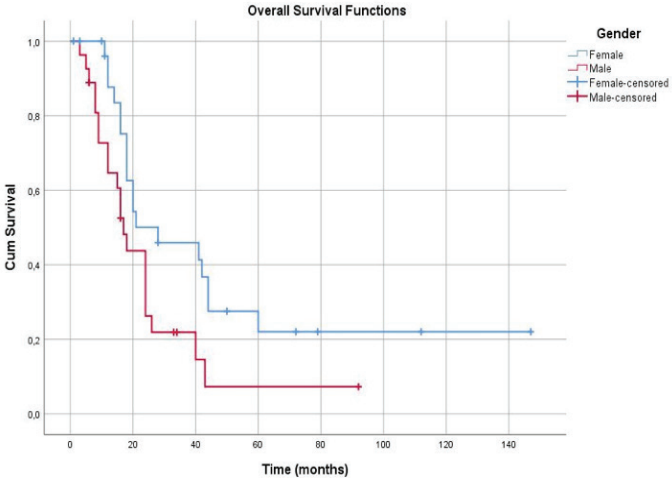

Figure 3. Survival analysis of patients according to gender.

Table 2. Survival analysis of patients

	Overall survival (mean ± SD, range) (month)	p-value
Gender		
Male	24.40±4.91 (3-92)	**0.031**
Female	52.88±10.92 (1-147)	
Neutrophil-lymphocyte ratio (NLR)		
NLR <3	61.26±13.03 (3-79)	**0.012**
NLR ≥3	23.18±13.03 (1-147)	
Lymphocyte-monocyte ratio (LMR)		
LMR <3	39.01±9.20 (3-147)	0.351
LMR ≥3	40.97±8.36 (1-112)	
Platelet-lymphocyte ratio (PLR)		
PLR (<149 men, <172 women)	45.19±9.62 (8-112)	0.148
PLR (≥149 men, ≥172 women)	36.13±8.18 (1-147) 0.148	
Pan-immune inflammation value (PIV)		
PIV <513,92	38.27±6.69 (25.16-51.39)	0.662
PIV ≥513,92	38.11±11.67 (15.23-60.98)	
SD: Standard deviation.		

Discussion

At present, there are numerous publications in literature suggesting that inflammatory cells associated with cancer are neutrophils, platelets and lymphocytes. In particular, NLR has been associated with poor survival in various malignancies such as lung cancer, colorectal cancers, hepatocellular carcinoma and prostate cancer.[14-18] In a meta-analysis investigating prognostic effect of NLR in cancer patients, it was stated that high NLR was associated with a poor overall survival, although prospective analyses with large series for each cancer type were specifically recommended.[19]

As it is known, MPM is an aggressive and treatment-resistant tumor with an increasing frequency all over the world. While there were debates about treatment in past, multimodal treatment method has been accepted today. In this context, the most commonly used method is HITHOC treatment combined with pleurectomy ± decortication. There are studies indicating that HITHOC treatment combined with cytoreductive surgery has a positive effect on survival in MPM.[20] Despite this accepted multimodality treatment in MPM, survival rates are still not encouraging. Therefore, it is very important to determine prognosis of the disease.

The effect of inflammatory markers, on prognosis of MPM is also frequently discussed. Cihan et al.[21] revealed that NLR and PLR were factors associated with survival in their study including 50 patients diagnosed with MPM. Pinato et al.[22] stated in their series including 171 MPM patients that female gender, epithelioid histology, normal C-reactive protein, NLR and PLR were prognostic markers in univariate analyses, but only NLR maintained this feature in multivariate analyses. As in these studies, in another study including 25 patients who did not receive any surgical treatment, it was reported that high NLR was associated with worse survival in survival analyzes performed according to threshold value determined for NLR (threshold value: 3).[11] In another study conducted in a heterogeneous group in terms of treatment applied and including 468 patients, it was stated that there was lower survival in those with high NLR.[23]

In addition, in a meta-analysis on prognostic importance of NLR in

Table 3. Multivariate Cox regression analysis for overall survival

Variable	Hazard ratio	95% confidence interval	p-value
Male gender	2.12	1.09-4.13	**0.028**
High neutrophil-lymphocyte ratio	2.36	1.21-4.62	**0.012**

patients with MPM, it was reported that high NLR could be a potential prognostic factor and could be used together with histology as an effective clinical index to classify patients.[9] In our study, OS was found to be 61.26±13.03 (3-79) months in cases with low NLR, while it was 23.18±3.53 (1-147) months in cases with high NLR, thus NLR was demonstrated to be a statistically significant prognostic factor for survival. In addition, another independent prognostic factor was determined to be male gender, consistent with literature. Furthermore, in this study, multivariate Cox regression analysis demonstrated that both high NLR and male gender were independently associated with overall survival. Male gender was associated with an approximately twofold increase in the risk of death, whereas high NLR was associated with more than a twofold increase in mortality risk. These findings underscore the prognostic importance of systemic inflammatory burden and suggest that an elevated inflammatory response may play a critical role in survival outcomes.

However, no relationship was found between PLR, LMR and OS. There are very few studies in literature investigating survival in patients with MPM and LMR. Yamagishi et al.[24] emphasized that survival is better in patients with LMR of 2.74 and above, contrary to NLR. In our study, threshold value for LMR was set as 3 and although longer survival was found in those above this threshold, it was not statistically significant. PIV is a popular inflammatory marker nowadays. There are many studies on PIV, which is calculated based on inflammatory cells. Lin et al.[25] reported that high PIV value was associated with poor survival in breast cancer, while Zhao et al.[12] reported that PIV was highly correlated with tumor stage in colorectal cancer patients. In a meta-analysis on predictive value of PIV for cancer prognosis, it was emphasized that PIV was a prognostic biomarker in non-metastatic cancer patients who did not receive immunotherapy/targeted therapy.[26] However, there ise one study in the literature investigating relationship between PIV value and survival in patients with MPM. Of the 115 patients included in this study, 87 were diagnosed with MPM and 28 with malignant peritoneal mesothelioma. All patients were in metastatic stage and received palliative CT. The threshold value for PIV was determined as 638. It was revealed that OS of patients with PIV above this value was statistically worse.[13] In our study, the patient group consisted only of MPM cases, and all patients received the same treatment regimen. However, survival analyses for PIV showed no statistically significant difference between the groups.

This study has several limitations that should be considered when interpreting the results. First, its retrospective and single-center design may limit the generalizability of the findings to other institutions and patient populations. Second, the relatively small sample size may have reduced the statistical power of the analyses, particularly for non-significant findings, and limited the inclusion of all potential confounding variables in a single multivariable model. Finally, although ROC analyses were performed, statistically specific cut-off values could not be identified. Given the limited sample size and the time-to-event nature of OS cut-off values may be unstable; therefore, literature-based thresholds were used.

As with all cancers, efforts to predict prognosis for MPM are ongoing. Considering that MPM has a very poor prognosis, these predictions become even more important. In our study, NLR was found to be associated with survival in general agreement with the literature, thus distinguishing it from other inflammatory markers as a prognostic factor. In clinical practice, predicting prognosis of patients according to pre-treatment NLR will provide a valuable argument to decide on treatment to be applied, to determine need for adjuvant treatment if surgery is to be performed, and to adjust type/frequency of follow-up.

Ethics

Ethics Committee Approval: Approval was obtained from the Local Ethics Committee of Ege University for the study, which was designed as a retrospective study (approval no: 22-2T/44, date: 08.02.2024).

Informed Consent: A written informed consent was obtained from each patient.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.K.T., H.Y., G.K.Ö., T.İ.A., A.G.E., K.T., A.Ç., U.Ç.; Concept: A.K.T., H.Y., G.K.Ö., T.İ.A.; Design: A.K.T., H.Y., T.İ.A.; Data Collection or Processing: A.K.T., H.Y., G.K.Ö., A.G.E., K.T., A.Ç., U.Ç.; Analysis or Interpretation: A.K.T., H.Y., T.İ.A., A.G.E., K.T.; Literature Search: A.K.T., H.Y., G.K.Ö.; Writing: A.K.T., H.Y., G.K.Ö.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Okabe K. Intraoperative intracavitary hyperthermic chemotherapy for malignant pleural mesothelioma. Ann Transl Med. 2017;5:233. doi: 10.21037/atm.2017.03.78.
2. Opitz I, Sigrist B, Hillinger S, Lardinois D, Stahel R, Weder W, et al. Taurolidine and povidone-iodine induce different types of cell death in malignant pleural mesothelioma. Lung Cancer. 2007;56:327-36. doi: 10.1016/j.lungcan.2007.01.024.
3. Janssen-Heijnen ML, Damhuis RA, Klinkhamer PJ, Schipper RM, Coebergh JW. Increased but low incidence and poor survival of malignant mesothelioma in the southeastern part of the Netherlands since 1970: a population-based study. Eur J Cancer Prev. 1999;8:311-4. doi: 10.1097/00008469-199908000-00007.
4. Boylan AM. Mesothelioma: new concepts in diagnosis and management. Curr Opin Pulm Med. 2000;6:157-63. doi: 10.1097/00063198-200003000-00013.
5. Ried M, Potzger T, Braune N, Neu R, Zausig Y, Schalke B, et al. Cytoreductive surgery and hyperthermic intrathoracic chemotherapy perfusion for malignant pleural tumours: perioperative management and clinical experience. Eur J Cardiothorac Surg. 2013;43:801-7. doi: 10.1093/ejcts/ezs418.
6. Carpagnano GE, Palladino GP, Lacedonia D, Koutelou A, Orlando S, Foschino-Barbaro MP. Neutrophilic airways inflammation in lung cancer: the role of exhaled LTB-4 and IL-8. BMC Cancer. 2011;11:226. doi: 10.1186/1471-2407-11-226.
7. Ebinç S, Oruç Z, Kalkan Z, Karhan O, Urakçı Z, Küçüköner M, et al. Prognostic factors and the prognostic role of inflammation indices in malignant pleural mesothelioma. Turk Gogus Kalp Damar Cerrahisi Derg. 2023;31:105-15. doi: 10.5606/tgkdc.dergisi.2023.23365.

8. Abakay O, Tanrikulu AC, Palanci Y, Abakay A. The value of inflammatory parameters in the prognosis of malignant mesothelioma. J Int Med Res. 2014;42:554-65. doi: 10.1177/0300060513504163..

9. Chen N, Liu S, Huang L, Li W, Yang W, Cong T, et al. Prognostic significance of neutrophil-to-lymphocyte ratio in patients with malignant pleural mesothelioma: a meta-analysis. Oncotarget. 2017;8:57460-9. doi: 10.18632/oncotarget.15404.

10. Wolf AS, Eisele M, Giroux DJ, Gill R, Nowak AK, Bille A, et al. The international association for the study of lung cancer pleural mesothelioma staging project: expanded database to inform revisions in the ninth edition of the TNM classification of pleural mesothelioma. J Thorac Oncol. 2024;19:1242-52. doi: 10.1016/j.jtho.2024.01.018.

11. Gutierrez-Sainz L, Cruz P, Martinez-Recio S, Higuera O, Esteban-Rodriguez MI, Arias-Lotto F, et al. Malignant pleural mesothelioma: clinical experience and prognostic value of derived neutrophil-to-lymphocyte ratio and PD-L1 expression. Clin Transl Oncol. 2021;23:2030-5. doi: 10.1007/s12094-021-02605-w.

12. Zhao H, Chen X, Zhang W, Cheng D, Lu Y, Wang C, et al. Pan-immune-inflammation value is associated with the clinical stage of colorectal cancer. Front Surg. 2022;9:996844. doi: 10.3389/fsurg.2022.996844.

13. Mutlu E, Inanc M. Prognostic significance of inflammation scores in malignant mesothelioma. Eur Rev Med Pharmacol Sci. 2024;28:2340-50. doi: 10.26355/eurrev_202403_35741.

14. Guthrie GJ, Roxburgh CS, Farhan-Alanie OM, Horgan PG, McMillan DC. Comparison of the prognostic value of longitudinal measurements of systemic inflammation in patients undergoing curative resection of colorectal cancer. Br J Cancer. 2013;109:24-8. doi: 10.1038/bjc.2013.330.

15. Oh BS, Jang JW, Kwon JH, You CR, Chung KW, Kay CS, et al. Prognostic value of C-reactive protein and neutrophil-to-lymphocyte ratio in patients with hepatocellular carcinoma. BMC Cancer. 2013;13:78. doi: 10.1186/1471-2407-13-78.

16. Gu X, Gao X, Li X, Qi X, Ma M, Qin S, et al. Prognostic significance of neutrophil-to-lymphocyte ratio in prostate cancer: evidence from 16,266 patients. Sci Rep. 2016;6:22089. doi: 10.1038/srep22089.

17. Lohinai Z, Bonanno L, Aksarin A, Pavan A, Megyesfalvi Z, Santa B, et al. Neutrophil-lymphocyte ratio is prognostic in early stage resected small-cell lung cancer. PeerJ. 2019;7:e7232. doi: 10.7717/peerj.7232.

18. Takahashi Y, Horio H, Hato T, Harada M, Matsutani N, Morita S, et al. Prognostic significance of preoperative neutrophil-lymphocyte ratios in patients with stage I non-small cell lung cancer after complete resection. Ann Surg Oncol. 2015;22(Suppl 3):S1324-31. doi: 10.1245/s10434-015-4735-5.

19. Mei Z, Shi L, Wang B, Yang J, Xiao Z, Du P, et al. Prognostic role of pretreatment blood neutrophil-to-lymphocyte ratio in advanced cancer survivors: a systematic review and meta-analysis of 66 cohort studies. Cancer Treat Rev. 2017;58:1-13. doi: 10.1016/j.ctrv.2017.05.005.

20. Luzzi L, Franchi F, Dapoto A, Ghisalberti M, Corzani R, Marrelli D, et al. Hyperthermic intrathoracic chemotherapy after extended pleurectomy and decortication for malignant pleura mesothelioma: an observational study on outcome and microcirculatory changes. J Thorac Dis. 2018;10(Suppl 2):S228-36. doi: 10.21037/jtd.2018.01.10.

21. Cihan YB, Ozturk A, Mutlu H. Relationship between prognosis and neutrophil: lymphocyte and platelet:lymphocyte ratios in patients with malignant pleural mesotheliomas. Asian Pac J Cancer Prev. 2014;15:2061-7. doi: 10.7314/apjcp.2014.15.5.2061.

22. Pinato DJ, Mauri FA, Ramakrishnan R, Wahab L, Lloyd T, Sharma R. Inflammation-based prognostic indices in malignant pleural mesothelioma. J Thorac Oncol. 2012;7:587-94. doi: 10.1097/JTO.0b013e31823f45c1.

23. Fournel L, Charrier T, Huriet M, Iaffaldano A, Lupo A, Damotte D, et al. Prognostic impact of inflammation in malignant pleural mesothelioma: a large-scale analysis of consecutive patients. Lung Cancer. 2022;166:221-7. doi: 10.1016/j.lungcan.2022.03.014.

24. Yamagishi T, Fujimoto N, Nishi H, Miyamoto Y, Hara N, Asano M, et al. Prognostic significance of the lymphocyte-to-monocyte ratio in patients with malignant pleural mesothelioma. Lung Cancer. 2015;90:111-7. doi: 10.1016/j.lungcan.2015.07.014.

25. Lin F, Zhang LP, Xie SY, Huang HY, Chen XY, Jiang TC, et al. Pan-immune-inflammation value: a new prognostic index in operative breast cancer. Front Oncol. 2022;12:830138. doi: 10.3389/fonc.2022.830138.

26. Guven DC, Sahin TK, Erul E, Kilickap S, Gambichler T, Aksoy S. The association between the pan-immune-inflammation value and cancer prognosis: a systematic review and meta-analysis. Cancers (Basel). 2022;14:2675. doi: 10.3390/cancers14112675.