Original Article/Özgün Makale

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.778080
J Health Sci Med 2020; 3(4): 421-426

The role of the C-reactive protein/albumin ratio in determining prognosis of patients diagnosed with small cell lung cancer and the relationship with the diameter and SUVmax value of primer mass in PET-CT

Küçük hücreli akciğer kanseri tanısı konulan hastalarda C-reaktif protein/albumin oranının prognoz tayinindeki yeri ile PET-BT'deki primer kitlenin çapı ve SUVmax değeri ile ilişkisi

Berna Akıncı Özyürek[1], Derya Yenibertiz[1], Aslıhan Gürün Kaya[2], İnci Uslu[3], Sertaç Büyükyaylacı Özden[1], Yurdanur Erdoğan[1]

[1]Ataturk Chest Diseases and Thoracic Surgery Education and Research Hospital, Chest Diseases, Ankara, Turkey
[2]Ankara University, Faculty of Medicine, Department of Pulmonary Medicine, Ankara, Turkey
[3]Ataturk Chest Diseases And Chest Surgery Education and Research Hospital, Nuclear Medicine Clinic, Ankara, Turkey

Cite this article as/Bu makaleye atıf için: Akıncı Özyürek B, Yenibertiz D, Gürün Kaya A, Uslu İ, Büyükyaylacı Özden S, Erdoğan Y. The role of the C-reactive protein/albumin ratio in determining prognosis of patients diagnosed with small cell lung cancer and the relationship with the diameter and SUVmax value of primer mass in PET-CT. J Health Sci Med 2020; 3(4): 421-426.

ABSTRACT

Introduction: In our study, we aimed to evaluate retrospectively the role of C-reactive protein/albumin rate (CAR) in determining prognosis of patients diagnosed with SCLC and the relationship with the diameter and SUVmax value of primer mass in positron emission tomography/computed tomography. **Material and Method:** A total of 70 patients diagnosed with SCLC between January 2008 and December 2015 in this study. Informations of patients were recorded. Hemogram at the time of first diagnosis, biochemistry values, diameter of the primary mass in PET-CT, SUVmax values, cancer stage, survival times were recorded. NLR: neutrophil lymphocyte, CAR: C-reactive protein/albumin ratios were calculated.

Results: The mean age of the patients was 57.6±7.5. While 59 (84.3%) patients were dead, 11 (15.7%) patients were still alive. The median follow-up time of the patients was 13. 7 (8.1-30.1) month. The mean life span was found to be 21 month in patients with CAR<0.3, and it was found to be 10 month in patients with CAR≥0.3 (p=0.007). Median lifespan was 23 month in patients with LDH<187 and it was 10 month in patients with≥187 (p=0.048). Median life span was found as 19 month in patients with NLR<3 and it was found to be 10 month in patients with NLR≥3. The result was evaluated as close to statistical significance (p=0.073).

Conclusion: We detected that male gender, the stage of disease, the increase of SUVmax value of primary mass and increased CAR, NLR and LDH levels were found to be poor prognostic criterias in SCLC patients. We consider that CAR, NLR and LDH levels can be used for forecasting of mortality at the beginning of the diagnoses of SCLC.

Keywords: Small cell lung cancer, C-reactive protein, albumin, mortality

ÖZ

Giriş: Küçük hücreli akciğer kanseri (KHAK) tüm akciğer kanser türlerinin %15'ini oluşturur. Çalışmamızda KHAK tanısı konulan hastalarda retrospektif olarak ilk tanı anında bakılan C-reaktif protein/albümin (CAR)'ın prognoz tayinindeki yeri ile primer kitlenin PET-BT'deki çapı ve SUVmax değeri ile ilişkisinin değerlendirilmesini amaçladık.

Gereç ve Yöntem: Çalışmamızda hastanemiz 8. kliniğinde Ocak 2008-Aralık 2015 tarihleri arasında KHAK tanısı konulan70 hasta dahil edildi. Hastalara ait bilgiler hasta dosyaları ve hastane bilgi sisteminden retrospektif olarak elde edildi. İlk tanı anında bakılan hemogram, biyokimya değerleri, PET-BT'deki primer kitlenin çapı, SUVmax değerleri, kanser evresi, sağkalım süreleri kayıtedildi. NLR: nötrofil/lenfosit, CAR: C-reaktif protein/albümin oranları hesaplandı.

Bulgular: Hastaların ortalama yaşı 57,6±7,5 olarak hesaplandı. 59 (%84,3) hasta exitus iken, 11 (%15,7) hasta halen sağ idi. Hastaların median izlem süresi 13,7 (8,1-30,1) ay idi. CAR<0,3 olanlarda ortalama yaşam süresi 21 ay iken; ≥0,3 olanlar da 10 ay olarak bulundu (p=0,007). LDH<187 olanlarda median ömür 23 ay; ≥187 olanlarda ise 10 ay olarak bulunmuştur (p=0,048). NLR<3 olanlarda median yaşam süresi 19 ay; ≥3 olanlarda 10 ay olarak bulunmuştur. Sonuç istatistiksel olarak anlamlılık sınırına yakın olarak değerlendirilmiştir (p=0,073).

Sonuç: Erkek cinsiyet, hastalığın evresi ve primer kitlenin SUVmax değerindeki artış, artmış CAR, artmış NLR ve artmış LDH KHAK'lı hastalarda kötü prognoz kriteleri olarak saptadık. CAR, NLR ve LDH düzeylerinin tanı anındaki mortaliteyi öngörmede kullanılabileceklerini düşünmekteyiz.

Anahtar kelimeler: Küçük hücreli akciğer kanseri, c-reaktif protein, albümin, mortalite

Corresponding Author/Sorumlu Yazar: Berna Akıncı Özyürek, Atatürk Göğüs Hastalıkları ve Göğüs Cerrahisi Eğitim ve Araştırma Hastanesi, Göğüs Hastalıkları Kliniği, Ankara, Türkiye
E-mail/E-posta: drberna_1982@yahoo.com
Received/Geliş: 07.08.2020 **Accepted/Kabul:** 07.10.2020

INTRODUCTION

Lung cancer is an increasingly common type of cancer worldwide. It is the most diagnosed cancer type and it is the most frequent cancer type in terms of cancer-related deaths. Five year survival rate is low, despite all the treatment options in lung cancer. Small cell lung cancer (SCLC) accounts for 15% of all lung cancer types. Complete blood count and biochemical tests are commonly used in the routine. The number of white cells, neutrophil and lymphocyte and the ratio of neutrophil/lymphocyte (NLR), hypoalbuminemia and C-reactive protein (CRP) are systemic inflammatory markers (1).

CRP is a positive acute phase reactant while albumin is a negative acute phase reactant. Acute phase proteins are also helpful in diagnosing malignant diseases and in determining the prognosis. The mortality is higher in elderly patients with high positive acute phase proteins or with low albumin value that is the one of the negative acute phase proteins (2,3).

The ratio of CRP/alb (CAR) was found to be associated with prognosis in many types of cancer, and also it was detected that it is independent risk factor in predicting the progression of patients with lung cancer (4). Positron emission tomography/computed tomography (PET-CT) is used to assess staging and the treatment response in patients diagnosed with malignancy. There are some studies that show the maximum standard uptake value (SUVmax) of the primary tumor is an independent prognostic factor.

Tumor size is also accepted to be a prognostic factor in non-small cell lung cancer (NSCLC) (5). It was shown that as tumor size increases, the value of SUVmax increases too (6-8). In one study, it was found that there was a positive correlation between tumor size and SUVmax (8). In our study it was aimed retrospectively to evaluate the relationship between the role of CAR detected at the beginning, in determining the prognosis of patients diagnosed with SCLC and the diameter and SUVmax value of primary mass in PET-CT.

MATERIAL AND METHOD

This study was approved by the university/local human research ethics committee and all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval of our study was received by applying to medical specialty training board of Ataturk Chest Diseases and Thoracic Surgery Education and Research Hospital, Chest Diseases with the date of 12.07.2018 and number of 604.

In our study 70 patients diagnosed with SCLC between January 2008 and December 2015 in 8th clinic of our hospital were included. The datas of the patients were obtained retrospectively from patient files. The hemogram and biochemistry values that detected at the time of initial diagnosis, the diameter and SUVmax value of primer mass in PET-CT used for staging. The stage of cancer, the performance status and smoking histories of patients, BMI and survival times were recorded. The patients with comorbid disease and with infectious disease were excluded from the study. Tumor size, taken into consideration the largest tumor diameter in the CT section, was determined in millimeters (mm). The clinical stage was classified on the basis of the American Joint Committee on Cancer 7th edition.

The following formulas were used:

- BMI: weight/height squared
- NLR: absolute neutrophyl count/absolute lymphocyte count
- CAR: CRP/albumine

PET-CT

A whole body scan was applied with a Siemens Biography 6 HI-REZ PET/CT scanner (Siemens Medical Solutions, Knoxville, Tennessee) to patients after at least 6 hours fast-and with blood glucose level k 180 mg/dL. The images of 6–8 bed positions from the base of the skull to high-thigh were obtained an hour after the intravenous bolus injection of fluorodeoxyglucose (FDG) at a dosage ranging from 370 to 555 MBq (10–15mCi). The patients were positioned with the arms above the head. A whole-body PET study followed an enhanced whole-body CT study and was used for attenuation correction.

Statistical Analyses

Statistical analyses were performed using the SPSS 22. The variables were investigated using histogram, probability plots and analytical methods (Kolmogorov-Smirnov/ Shapiro-Wilk's test) tı determine whether or not they are normally distributed. Descriptive analyses were presented using means and standard deviations for normally distributed and medians and interquartile range (IQR) fort he non-normally distributed and ordinal variables. The univariant analyses to identify variables of patient outcomes was investigated using chi-square, Fisher exact, Student's t and Mann-Whitney U test, where appropiate. For multivariant analyses, the possible factors identified with univariate analyses were further entered into logistic regression analysis to determine independent predictors of mortality. ROC (Receiver Operating Characteristics) curve analysis were used to determine cut-off value of LDH, CAR and NLR. The Kaplan-Meier survival estimates were calculated. A separate log rank test was used to identify the independent effect of LDH, CAR and NLR values on survival. A p-value of less than 0.05 was considered to show a statistically significant result.

RESULTS

In this study, we retrospectively analyzed the prognostic power of CRP/Alb ratio in 70 eligible patients with SCLC. Men were 90% (N:63) of those participating in the study. The mean age of the patients was 57.6±7.5. The number of the exitus patients was 59 (84.3%), while 11 patients (15.7%) were still alive. The median monitoring time of the patients was 13.7 (8.1-30.1) month.

The average smoking history of patients was 40 packets/years. 27 patients were staged as. The number of limited stage patients with SCLC was 27 and 43 patients were staged as extensive stage SCLC. The mean diameter of mass was calculated as 6.68±2.8 cm. The median SUVmax value of the primary mass was 13.43 (13.49-18.18).

The comparison of the general characteristics of limited stage and extensive stage patients with SCLC was shown in **Table 1**. There was a statistically significant difference in terms of the mean LDH levels and the monitoring times between two groups.

Table 1. The comparison of the general characteristics of patients with limited and extensive stage SCLC

	Limited stage	Extensive stage	p
Cigarette Pc-Year	40 (35-50)	40 (30-56)	0.942
SUVmax	13.44 (10.10-16.85)	13.43 (11.1-19.24)	0.567
RDW	14.1 (13.5-14.9)	13.9 (13.4-14.8)	0.763
PLT	289 (242-368)	294 (225-356)	0.484
CRP	1.32 (0.6-5.5)	2.78 (1.1-6.2)	0.319
CAR	0.34 (0.17-1.54)	0.92 (0.27-1.81)	0.275
NLR	2.88 (2.13-4.38)	3.30 (2.41-4.50)	0.175
LDH	187 (168-242)	215 (180-427)	0.026
Monitoring times (month)	23.7 (10.1-37.25)	10.6 (6.2-21.15)	0.009

CAR: CRP/albümine ratio, RDW: Red cell distribution width, PLT:platelet, NLR: neutrophyl count/lymphocyte count ratio, LDH: Lactate dehydrogenase, CRP: C-reactive protein

According to the ROC curve analysis, the cut-off value of CAR was 0.3, the cut-off value of NLR was 3, and also the cut-off value of LDH was 187.

The average life span was 21 months in patients with CAR<0.3, while it was 10 months in patients with CAR≥0.3. The survival distinction was statistically significant (p=0.007) (**Figure 1**). It was found that the median life-span was 23 months in the patients with LDH<187 and it was 10 month in the patients with LDH≥187 (p=0.048) (**Figure 2**).

Median life span was found to be 19 months in patients with NLR<3, it was found to be 10 months in patients with NLR≥3 years. The result was evaluated as close to statistical significance (p=0.073) (**Figure 3**).

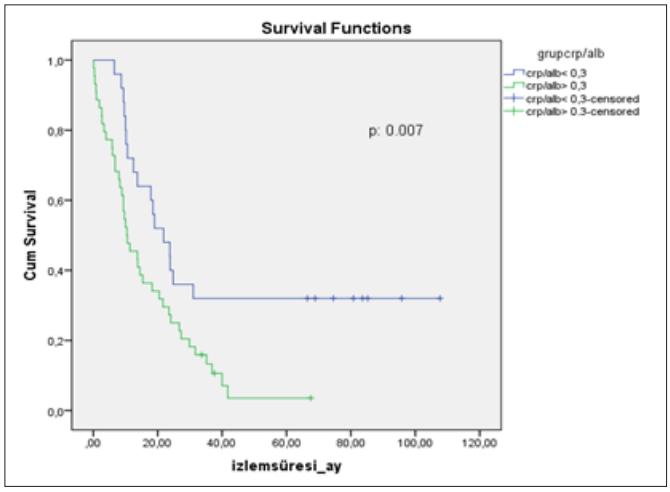

Figure 1. The relationship between the CAR and the survival

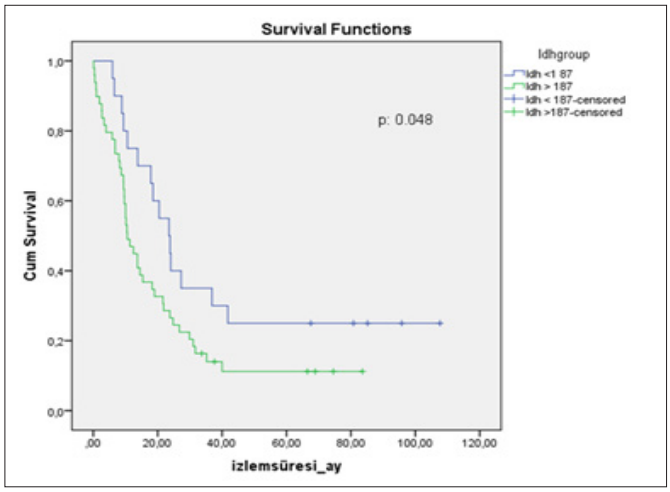

Figure 2. The relationship between the LDH and the survival

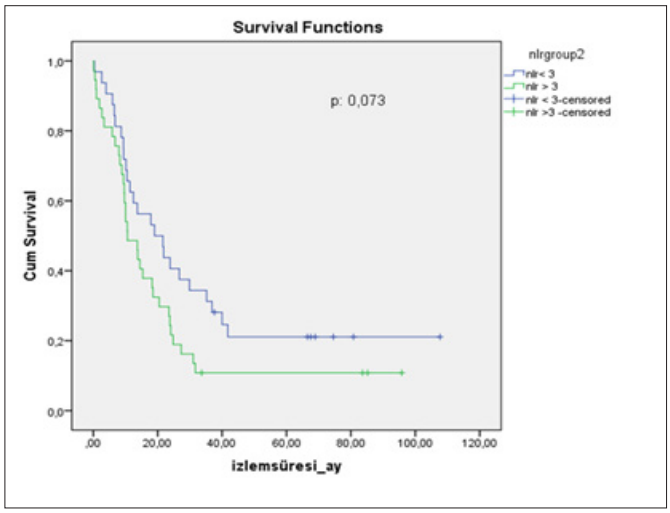

Figure 3. The relationship between the NLR and the survival

Hemogram parameters of both groups were compared and no significant difference was detected. Tumor diameter and SUVmax values were also found to be similar.

The age, the gender and the mortality rates of the patients, the diameter and the SUVmax values of primary mass were compared according to the cut-off value of CAR. They are shown in **Table 2**. No statistical difference was found. The mortality rate was found to be low in patients with CAR<0.3 (p=0.008).

Table 2. The comparison of the properties of SCLC patients according to the high and low CAR values

	CAR<0.3	CAR≥0.3	P
Gender (male %)	88.0%	91.1%	0.487
Age (mean±SD)	59.8±7.05	56.47±7.62	0.076
Diameter of primary mass (mean±SD)	7.18±3.21	6.40±2.64	0.278
SUVmax value of primary mass (Median [IQR 25-75])	13.53 [11.66-17.52]	13.0 [10.00-18.97]	0.695
Stage (limited stage %)	52.0%	31.1%	0.07
Mortality %	68%	93.3%	0.008

CAR: CRP/alb ratio

It was determined that the age, the gender, the stage of disease, the diameter and the SUVmax value of primary mass, the NLR, the CAR and the LDH values didn't affect independently mortality but it was detected that the male gender, the stage, the SUVmax value of the primary mass and the NLR values were close to the statistical significance limit according to the results of logistic regression analysis conducted with the aim of examining the risk factors for mortality in SCLC (**Table 3**).

Table 3. The risk factors affecting mortality in patients with SCLC according to logistic regression analysis

Risk factor	RR (%95 Cl)	p
Age	0.96 (0.836-1.10)	0.587
Gender (male/female)	18.6 (0.93-372.47)	0.055
Stage (limited/extensive)	0.2 (0.06-1.04)	0.057
The diameter of primary mass	1.30 (0.84-2.02)	0.230
SUVmax	0.90 (0.814-1.07)	0.066
NLR	0.57 (0.32-1.00)	0.052
CAR	1.60 (0.81-3,14)	0.160
LDH	1.00 (0.99-1.00)	0.920

CAR: CRP/albumine ratio, NLR: neutrophyl count/lymphocyte count ratio, LDH: Lactate dehydrogenase

DISCUSSION

It is known that elevated LDH levels correlate with inflammation and tumor necrosis and therefore it reflects tumor activity. It is well known that high LDH level is a prognostic factor and detected in many malignancies, especially lymphoma, small cell lung carcinoma and germ cell tumors. Some studies have also shown that high serum LDH level is a poor prognostic factor in patients with NSCLC too (9,10). LDH is a prognostic and potential pro tumor factor in patients with lung cancer. In patients with SCLC, a poor correlation was detected between increased LDH levels and survival and it has been recommended that serum LDH levels and other prognostic factors to be evaluated together (11).

LDH is a biochemical parameter especially high in patients with extensive stage SCLC. Increased LDH levels are associated with short median survival in patients with both limited and extensive stage SCLC. Patients with normal LDH levels have better prognosis than patients with increased LDH levels. The 1-year mortality was determined as 33.1% in cases with normal LDH level and as 60.2% in cases with increased LDH levels. It was found that LDH levels at the beginning of diagnosis were associated with prognosis in patients with SCLC (12). In our study median life span was detected as 23 months in patients with low LDH level and it was detected as 10 month in patients with high LDH level. The LDH levels were found to be lower in patients with limited stage SCLC compared to the patients with extensive stage SCLC (187-215 in order). Analysis of LDH subgroups may provide clearer datas in terms of prognose. Albumin can reflect the nutritional status of patients with cancers and malnutrition is correlated with worse survival (13). It has been shown in several studies that the albumin level detected low at the beginning of the diagnose in patients with cancers is a prognostic factor and it is related to the short duration of survival (14). In our study, the level of albumin was found higher in patients with limited stage than in patients with extensive stage. There was no statistically significant difference. This result may be due to the fact that the numbers of patients were not equal in the two groups.

Systemic inflammation is also linked to poor outcome in cancer patients. CRP is a sensitive and reliable prognostic marker for systemic inflammation that is also convenient for testing with standardized parameters established in clinical laboratories. In a study of 592 lung cancer patients and 670 control subjects, pre-diagnostic elevated CRP was found to be associated with an increased risk of lung cancer development (15). Previous studies have reported that elevated CRP level can affect the growth and progression of cancer. Hong et al. (16) observed that high CRP level is associated with poor prognosis of patients with SCLC. CRP levels were determined lower in patients with limited stage compared to patients with extensive stage. CRP and albumin ratio, a new index, may have prognostic value in inflammation and better predict overall survival of patients with cancer. The CAR is a readily available biomarker. Recently, the effect of CAR on prognosis in the various tumors has been shown in many studies. It is an independent prognostic factor. CAR has been found to be a poor prognostic factor in pancreatic cancer, nasopharyngeal cancer, colorectal

cancer and esophageal cancer (4). In another study, it was detected that CAR was associated with progression and mortality in operable NSCLC and SCLC (4). In this study, a 0.3 cut off value for CAR was used for predicting overall survival in SCLC. The mean life span was 21 month in patients with CAR<0.3, and 10 month in patients with CAR≥0.3. The mortality rate was found to be high in patients with CAR≥0.3. In accordance with the literature, we found that CAR is a prognostic factor in determining mortality in SCLC.

It is thought that PET/CT frequently used in diagnosis and staging of cancer, is a noninvasive method for determining the prognosis of the tumor. In a retrospective study, the average of SUVmax value of primary tumors was 11.1 and it was determined that there wasn't significantly difference between the below and above of this value in terms of survival (17). When the relation between the increase of SUVmax value and mortality was evaluated in the logistic regression analysis performed in our study, it was found to be close to the statistical significance limit. There are some studies having showed that the SUVmax value increases as the tumor size increases (8). In the study of Brown et al. (18) all histological subtypes of lung cancer were evaluated together and it was determined that the increase of SUVmax and tumor size was in positively correlation but when it was evaluated according to the histological subgroups there was a correlation between tumor size and SUVmax value in patients with adenocarcinoma while there was no significant correlation between tumor size and SUVmax value in patients with epidermoid carcinoma and large cell carcinoma. There are also some studies having showed that there is no correlation between tumor size and SUVmax value (19). In our study, we haven't found any relation between tumor size and SUVmax with survival. Leukocyte, neutrophil and lymphocyte count and neutrophil to lymphocyte ratio (NLR) are markers of systemic inflammation that are known to play main roles in cell-mediated destruction of cancer cells (20). NLR is an inexpensive, reproducible and widely available blood test. However elevated peripheral NLR before treatment was an independent prognostic factor of poor progressive free survival and overall survival in SCLC patients (21). In a study conducted in patients with lung cancer and with NLR<3, median survival time (31.08 month) was significantly longer than that of those with NLR≥3 (18 month) (22). In SCLC patients, no relationship could be found between NLR and median survival time (22). In our present study, the median life span was 19 month in patients with NLR<3, and it was 10 month in patients with NLR≥3. The result was evaluated to be close to the significance limit. More meaningful results will be obtained by increasing the number of patients. SCLC is a type of lung cancer that spreads rapidly and has an aggressive course. However it responds to the chemotherapy and radiotherapy well. In extensive stage, the survival rate without treatment is very low. The average life expectancy is longer in those patients with limited stage disease under treatment. Male gender is more prevalent, while female patients have a better prognosis than male patients (23). In our study, it was determined that male gender, stage of disease, SUVmax value of primary mass and NLR affect the prognosis and it is close to the statistical significance limit made by logistic regression analysis with the aim of examining the risk factors for mortality in SCLC. We think that to increase the number of patients will lead to more meaningful results.

CONCLUSION

As a result, we found that male gender, increased SUVmax value of mass, increased CAR, increased NLR, and increased LDH are poor prognostic criterias in patients with SCLC. We believe that CAR, NLR and LDH levels can be used for prediction of mortality at the diagnostic moment.

ETHICAL DECLARATIONS

Ethics Committee Approval: Approval of our study was received by applying to medical specialty training board of Atatürk Chest Diseases and Thoracic Surgery Education and Research Hospital, Chest Diseases with the date of 12.07.2018 and number of 604.

Informed Consent: Written informed consent form was obtained from all patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Kacan T, Babacan NA, Seker M, et al. Could the neutrophil to lymphocyte ratio be a poor prognostic factor for non small cell lung cancers? Asian Pac J Cancer Prev 2014; 15: 2089-94.
2. Harris TB, Ferrucci L, Tracy RP, et al. Associations of elevated interleukin-6 and C-reactive protein levels with mortality in the elderly. Am J Med 1999; 106: 506-12.
3. Klonoff-Cohen H, Barrett-Connor EL, Edelstein SL. Albumin levels as a predictor of mortality in the healthy elderly. J Clin Epidemiol 1992; 45: 207-12.

4. Koh YW, Lee HW. Prognostic impact of C-reactive protein/albumin ratio on the overall survival of patients with advanced nonsmall cell lung cancers receiving palliative chemotherapy. Medicine (Baltimore) 2017; 96: 6848.
5. Mery CM, Pappas AN, Burt BM, et al. Diameter of non-small cell lung cancer correlates with long-term survival: implications for T stage. Chest 2005; 128: 3255-60.
6. Brown RS, Leung JY, Kison PV, Zasadny KR, Flint A, Wahl RL. Glucose transporters and FDG uptake in untreated primary human non-small cell lung cancer. J Nucl Med 1999; 40: 5565.
7. Dooms C, van Baardwijk A, Verbeken E, et al. Association between 18F-fluoro-2-deoxy-D-glucose uptake values and tumor vitality: prognostic valueof positron emission tomography in early-stage non-small cell lung cancer. J Thorac Oncol 2009; 4: 822-8.
8. Li M, Liu N, Hu M, et al. Relationship between primary tumor luorodeoxyglucose uptake and nodal or distant metastases at presentation in T1 stage nonsmall cell lung cancer. Lung Cancer 2009; 63: 383-6.
9. Albain KS, Crowley JJ, LeBlanc M, Livingston RB. Survival determinants in extensive-stage non-small-cell lung cancer: the Southwest Oncology Group experience. J Clin Oncol 1991; 9: 1618-26.
10. Danner BC, Didilis VN, Wiemeyer S, et al. Long-term survival is linked to serum LDH and partly to tumour LDH-5 in NSCLC. Anticancer Res 2010; 30: 1347-51.
11. Zhang X, Guo M, Fan J, et al. Prognostic significance of serum LDH in small cell lung cancer: a systematic review with meta-analysis. Cancer Biomark 2016; 16: 415-23.
12. Tas F, Aydiner A, Demir C, Topuz E. Serum lactate dehydrogenase levels at presentation predict outcome of patients with limited-stage small-cell lung cancer. Am J Clin Oncol 2001; 24: 376-8.
13. Jin J, Liu D, Zhou Y, Li W. C-reactive protein to albümin ratio as prognostic factors in lung cancer. Int J Clin Exp Med 2017; 10: 16780-7.
14. Chatani M, Matayoshi Y, Masaki N, Inoue T. Radiation therapy for brain metastases from lung carcinoma. prospective randomized trial according to the level of lactate dehydrogenase. Strahlenther Onkol 1994; 170: 155-61.
15. Chaturvedi AK, Caporaso NE, Ktaki HA: C-reactive protein and risk of lung cancer. JCO. 2010; 28: 2719-26.
16. Hong S, Kang YA, Cho BC, Joon D, Yonsei K. elevated serum C-reactive protein as a prognostic marker in small cell lung cancer. Med J 2012; 53: 111-7.
17. Hoang JK, Hoagland LF, Coleman RE, Coan AD, Herndon JE II, Patz EF Jr. Prognostic value of fluorine-18 fluorodeoxyglucose positron emission tomography imaging in patients with advanced-stage nonsmall cell lung carcinoma. J Clin Oncol 2008; 26: 1459-64.
18. Brown RS, Leung JY, Kison PV, Zasadny KR, Flint A, Wahl RL. Glucose transporters and FDG uptake in untreated primary human non-small cell lung cancer. J Nucl Med 1999; 40: 556-65.
19. Soret M, Bacharach SL, Buvat I. Partial-volume effect in PET tumor ımaging. J Nucl Med 2007; 48: 932-45.
20. Kobayashi T, Teruya M, Kishiki T, et al. Inflammation-based prognostic score and number of lymph node metastases are independent prognostic factors in esophageal squamous cell carcinoma. Dig Surg 2010; 27: 232–7.
21. Deng M, Ma X, Liang X, Zhu C, Wang M. Are pretreatment neutrophil-lymphocyte ratio and platelet-lymphocyte ratio useful in predicting the outcomes of patients with small-cell lung cancer? Oncotarget 2017; 8: 37200-07.
22. Akinci Ozyurek B, Sahin Ozdemirel T, Buyukyaylaci Ozden S, Erdogan Y, Kaplan B, Kaplan T. Prognostic value of the neutrophil to lymphocyte ratio (NLR) in lung cancer cases. Asian Pac J Cancer Prev 2017; 18: 1417-21.
23. Souhami RL, Law K. Longevity in small cell lung cancer. a report to the Lung Cancer Subcommittee of the United Kingdom Coordinating Committee for Cancer Research. Br J Cancer 1990; 61: 584-9.