VIA MEDICA

ORIGINAL ARTICLE

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Effects of the changes between pre- and post-treatment ^{18}F-FDG PET-CT volumetric parameters on overall survival in pleural mesothelioma

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Oncology in Clinical Practice
DOI: 10.5603/OCP.2023.0022

ISSN 2450–1654
e-ISSN 2450–6478

ABSTRACT

Introduction. This study aimed to examine the efficacy of positron emission tomography in fusion with computed tomography (PET-CT) parameters in predicting survival outcomes for patients with malignant pleural mesothelioma.

Material and methods. This study retrospectively evaluated the data of 250 patients who were followed up after a diagnosis of malignant pleural mesothelioma. The relationship of pre-treatment [maximum standardized uptake value (SUV_{max1}), metabolic tumor volume (MTV1), total lesion glycolysis (TLG1), tumor/background (TBR1), pleural thickness1), post-treatment (SUV_{max2}, MTV2, TLG2, TBR2, pleural thickness2], and ΔPET-CT parameters with survival was retrospectively evaluated in 36 patients whose pre- and post-treatment CT scan examinations were complete.

Results. The median age of the patients was 57.5 years, ranging from 35 to 76. Median follow-up time was 16 months, with a range of 7 to 42 months. Median survival was calculated as 18.8 months for all patients. Based on the determined cut-off values, overall survival was determined as 29.9 months in patients with TLG2 ≤ 158 compared to 16 months in patients with TLG2 > 158 ($p = 0.009$) and as 30.9 months in patients with ΔTLG ≤ –62.58 compared to 16 months in patients with ΔTLG > –62.58 ($p = 0.001$). In addition, median overall survival (OS) was determined as 29.9 months in patients with MTV2 ≤ 63.9 compared to 16 months in patients with MTV2 > 63.9 ($p = 0.007$) and as 29.9 months in patients with ΔMTV ≤ –54.03 compared to 16 months in patients with ΔMTV > –54.03 ($p = 0.002$). When evaluated with respect to TBR2; median OS was 29.9 months in patients with TBR2 ≤ 1.84 compared to 16 months in patients with TBR2 > 1.84 ($p = 0.039$).

Conclusions. Our research findings indicate a correlation between OS and volumetric PET-CT measures, specifically TLG and MTV.

Keywords: mesothelioma, ^{18}F-FDG PET-CT, volumetric parameters
Oncol Clin Pract 2023; 19, 5: 309–317

Introduction

Mesothelioma is a primary malignant tumor of the mesothelial lining that originates from pleural, peritoneal, pericardial, and tunica vaginalis mesothelial cells. Pleural mesothelioma accounts for roughly 80% of all cases, and its incidence rises with age, with a median age at diagnosis of 72 years. The five-year survival rate after diagnosis is approximately 10% [1]. Pleural mesothelioma is more common in males and its incidence is increasing globally [2–4].

Received: 15.04.2023 Accepted: 18.04.2023 Early publication date: 29.05.2023

It has three subtypes, namely, epithelioid, sarcomatoid, and biphasic, based on the microscopic appearance of the histologically dominant malignant region. The most common histological subtype is the epithelioid type [5]. Asbestos and erionite represent the most important risk factors for the development of malignant pleural mesothelioma [6–8]. Asbestos exists in nature in the form of long fibers and has two main types, namely serpentine, and amphibole. The less carcinogenic serpentine fiber chrysotile constitutes more than 90% of all asbestos produced and used worldwide [9].

In the treatment of mesothelioma, multimodal approaches come to the fore. Unresectable patients and sarcomatoid-type mesotheliomas require chemotherapy treatment. In addition, targeted therapies and immunotherapy have been employed in the treatment in recent years. Although the current treatment approaches have resulted in an improvement in survival, the malignancy is still associated with quite poor 5-year survival.

Imaging techniques such as conventional radiography, computed tomography (CT), magnetic resonance imaging (MRI), and ^{18}F-FDG positron emission tomography in fusion with computed tomography (PET-CT) scans are employed in diagnosis and treatment.

With the advances in the treatment, imaging methods are gaining more importance and the development of various new response evaluation methods is among the popular topics. ^{18}F-FDG PET-CT is one of the most valuable imaging methods used in the diagnosis and treatment evaluation of patients with mesothelioma. The maximum standardized uptake value (SUV_{max}) on the pre-treatment PET-CT has a prognostic value [10]. The evaluation of post-chemotherapy treatment response is also quite critical in terms of treatment continuation or treatment change. Metabolic tumor parameters measured on PET-CT, such as SUV_{max} and SUV_{mean}, are useful in the evaluation of treatment response [11]. In addition to conventional imaging methods, metabolic tumor volume (MTV) and total lesion glycolysis (TLG) parameters are utilized to assess the efficacy of treatment in tumor response evaluation. Francis and colleagues conducted a study that demonstrated the superiority of metabolic tumor volume parameters, such as MTV and TLG, over SUV_{max} in predicting survival and evaluating treatment response [12].

In this study, we aimed to determine the demographic, clinical, and pathological characteristics of the patients we followed up and treated for pleural mesothelioma, as well as investigate the PET-CT parameters that best predict the treatment response and survival by examining treatment response in these patients.

Material and methods

Selection and evaluation of patients

This study retrospectively evaluated the data of 250 patients diagnosed with pleural mesothelioma in Dicle University, Medical Oncology Clinic between 2017 and 2022. Pre- and post-treatment ^{18}F-FDG PET-CT results could be obtained for 70 of the screened patients. This study analyzed only the results of 36 patients, as the interval between their pre-treatment and post-treatment ^{18}F-FDG PET-CT scans was shorter than 6 months. Patient files were examined to obtain information on age, sex, place of birth, tumor side, date of diagnosis, histological subtype, history of chemotherapy, and survival times.

The study included patients who were 18 years or older, diagnosed with pleural mesothelioma, and had received chemotherapy treatment. The patients had undergone ^{18}F-FDG PET-CT scans both before and after the chemotherapy, which was conducted at either the Nuclear Medicine Department of Dicle University, Faculty of Medicine, or Gazi Yasargil Training and Research Hospital. Patients with a second primary malignancy diagnosis or pleural effusion, patients followed-up or treated at external centers, patients who underwent the two ^{18}F-FDG PET-CT scans with an interval longer than 6 months, and patients whose data could not be obtained were excluded from the study.

Patient files, demographic characteristics, and clinical characteristics were examined; prognostic factors associated with the patients and their treatments were investigated; survival analyses were conducted. The histological type of the tumor was inspected. Overall survival was calculated for the entire population and was analyzed in relation to the semi-quantitative and quantitative parameters from the baseline and interim ^{18}F-FDG PET-CT examinations, which included SUV_{max}, MTV, TLG, percent change in SUV_{max} (ΔSUV_{max}) and TLG (ΔTLG), pleural thickness. Pre-treatment parameters were defined as SUV_{max1}, MTV1, TLG1, tumor/background (TBR1), pleural thickness1; while post-treatment parameters were defined as SUV_{max2}, MTV2, TLG2, TBR2, and pleural thickness2. The differences between the pre-treatment and post-treatment parameters were presented as Δ values.

In this study, OS was defined as the duration from the date of the pre-treatment ^{18}F-FDG PET-CT scan to the date of death or the latest follow-up examination. Progression-free survival (PFS) was defined as the length of time from the start of treatment either to the date of disease progression, the decision to change treatment due to inadequate treatment response, or the last follow-up examination.

Ethical approval was obtained for this study from Dicle University, Faculty of Medicine Non-Invasional Clinical Research Ethics Committee (date: 12.05.2022, approval number: 133).

The ^{18}F-FDG PET-CT imaging protocol for all patients in the study involved a 6-hour fasting period, during which they refrained from consuming food and intravenous glucose. Before FDG injection, a finger stick method was used to confirm that blood glucose levels were ≤ 140 mg/dL. One hour after injection of ^{18}F-FDG at a dose of 3.5–5.5 MBq/kg, scans were obtained from the vertex to mid-thigh while the patients were in a supine position, using either a Discovery IQ 4 ring 20 cm axial FOV PET-CT device (GE Healthcare, Milwaukee, WI, US) or a Siemens Horizon PET-CT device (Siemens Knoxville, TX, US). Non-ionic contrast medium was injected intravenously in all patients who did not have a contraindication.

Evaluation of ^{18}F-FDG PET-CT images

Standardized uptake value is the concentration of radioactivity within the volume of interest (kBq/mL)/ /concentration of injected radioactivity (kBq)/body weight in grams. Among SUV values, SUV_{max} is the one that is used most commonly in clinical practice. The calculation of the SUV_{max} value involves the measurement obtained from the pixel with the highest activity within the region of interest drawn around the lesion. Metabolic tumor volume represents the three-dimensional total volume measured with the region of interest (ROI) drawn around the lesion. In turn, TLG is obtained by the multiplication of the MTV and SUV_{mean} values.

For this study, all ^{18}F-FDG PET-CT images were analyzed using Advantage Workstation software version AW 4.7 (GE Healthcare, Milwaukee, WI, US) by two nuclear medicine specialists, each with a minimum of 10 years of experience in the field. Volumetric regions of interest (VOI) were manually drawn to involve the tumor tissue in all three planes. Metabolic tumor volume and TLG (MTV × SUV_{mean}) values, SUV_{max}, SUV_{peak}, and highest SUV_{peak} values were automatically provided by the device at a 40% SUV threshold. Additionally, a 2-cm VOI was drawn from the liver to obtain SUV_{max} values for the background. TBR values were computed from the ratio of the SUV_{max} values from the tumor to background values. In addition, ΔMTV, ΔTLG, ΔSUV_{max}, ΔHighest SUV_{peak}, and Δthickness values were calculated as below.

The Δparameter was calculated using the formula: [(post-treatment parameter — pre-treatment parameter)/pre-treatment parameter × 100].

Statistical analysis

The statistical analysis of the data was conducted using SPSS 26 (Statistical Package Social Science) software. The Kolmogorov-Smirnov test was used to determine normality for numeric data, which were presented as mean (standard deviation) if normally distributed and as median (min-max) values if not. Categorical data were presented as percentages. Student's t-test was used to analyze normally distributed numeric data, while the Mann-Whitney U test was used for non-normally distributed numeric data. The chi-square test was used for categorical variables. Receiver-operating characteristic (ROC) curve analysis was performed to identify cut-off values, as well as sensitivity and specificity values for statistically significant variables. Survival analysis was conducted using the Kaplan-Meier method, and the log-rank test was used to compare survival rates. A p-value of < 0.05 was considered statistically significant.

Results

Of all the patients included in the study, 19 (52.8%) were male and 17 (47.2%) were female. The median age at diagnosis was 57.5 years (range: 35–76 years), and median follow-up time was 16 months (range: 7–42 months). Median OS was 18.8 months for all patients. Regarding histological subtypes, 31 (86.1%) patients had epithelioid, 2 (5.6%) patients had sarcomatoid, and 2 (5.6%) patients had mixed-type histology. Meanwhile, histological subtype data could not be obtained for one patient. When tumor localizations were evaluated; the tumor was localized within the right hemithorax in 16 (44.4%) patients, within the left hemithorax in 18 (50%) patients, and bilaterally in 2 (5.6%) patients. Tumor localization was costal-mediastinal-diaphragmatic (CMD) in 34 patients and costal in 2 patients. Systemic treatments included either pemetrexed plus platin (PMX + PLT) in 25 patients, or pemetrexed plus platin plus bevacizumab (PMX + PLT + Beva) in 11 patients (Tab. 1). The image of one of the patients included in our study who responded partially to treatment is shown in Figures 1 and 2.

Receiver-operating characteristic analyses performed with the outcome variable taken as death determined SUV_{max1}, TLG2, MTV2, ΔMTV, ΔTLG, ΔHighest SUV_{peak}, and TBR2 as statistically significant. For SUV_{max1}, sensitivity was 63% and specificity 62% at a cut-off value of 7.95. For TLG2, sensitivity was 57% and specificity 56% at a cut-off value of 158. For MTV2, sensitivity was 57% and specificity 62% at a cut-off value of 63.9. For ΔMTV, sensitivity was 68% and specificity 68% at a cut-off value of –54.03. For ΔTLG, sensitivity was 73% and specificity 75% at a cut-off value of –62.58. For ΔHighest SUV_{peak} sensitivity was 63% and specificity 62% at a cut-off value of –7.27. For Highest SUV_{peak2}, sensitivity was 57% and specificity

Table 1. General characteristics and parameter values of the patients

Parameters	n (%)
Age (median range)	57 (35–76)
Sex	
Male	19 (52.8)
Female	17 (47.2)
Histological subtypes	
Epithelioid	31 (86.1)
Sarcomatoid	2 (5.6)
Mixt	2 (5.6)
Hemithorax	
Right	16 (44.4)
Left	18 (50)
Bilateral	2 (5.6)
Localization	
CMD	34 (94.4)
Costal	2 (5.6)
First-line treatment options	
PMX + PLT	25 (69.4)
PMX + PLT + Beva	11 (30.6)
Parameters	**Median (range)**
Pre-treatment values	
MTV1 [cm^3]	113.5 (2.8–863)
TLG1 [mL × cm^3]	400.5 (8.5–5308)
SUV_{max1}	7.95 (2.1–28.9)
Highest SUV_{peak1}	5.2 (1.5–24.9)
TBR1	2.58 (0.55–12.57)
Pleural thickness1	17.5 (5–61)
Post-treatment values	
MTV2 [cm^3]	49.5 (0–980)
TLG2 [mL × cm^3]	158 (0–5447)
SUV_{max2}	6.25 (0–29)
Highest SUV_{peak2}	4.6 (0–25.5)
TBR2	1.84 (0–12)
Pleural thickness2	15.5 (4–64)
Δ Values	
ΔMTV [cm^3]	–54 (–100 to 582)
ΔTLG [mL × cm^3]	–62.58 (–100 to 1132)
ΔSUV_{max}	–22.22 (–100 to 100)
ΔHighest SUV_{peak}	–7.14 (–196 to 52)
ΔTBR	–30.85 (–100 to 105)
ΔPleural thickness	–11.32 (–78 to 260)

Beva — bevacizumab; CMD — costal-mediastinal-diaphragmatic; MTV — metabolic tumor volume; PLT — platin; PMX — pemetrexed; SUV_{max} — maximum standardized uptake value; TBR — tumor/background; TLG — total lesion glycolysis

56% at a cut-off value of 4.6. For TBR2, sensitivity was 63% and specificity 62% at a cut-off value of 1.84. The results of the ROC analyses are presented in Table 2 and Figure 3.

When the patients were evaluated with regard to survival parameters; median OS was calculated as 18.8 months (95% CI 13.9–23.6) for all patients. When the TLG2 value was transformed into a categorical variable by taking 158 as the cut-off value and introduced to survival analysis, median OS was 29.9 (95% CI 15.3––44.4) months in patients with TLG2 ≤ 158 and 16 (95% CI 9–23) months in patients with TLG2 > 158 (p = 0.009). When the patients were categorized into two groups: those with MTV2 values above and below 63.9, median OS was determined as 29.9 (95% CI 15.3–44.4) months in patients with MTV2 ≤ 63.9 and 16 (95% CI 8.9–23) months in patients with MTV2 > 63.9 (p = 0.007). Changes in ^{18}F-FDG PET-CT parameters based on the comparison of the results from post-treatment ^{18}F-FDG PET-CT scan data with pre-treatment ^{18}F-FDG PET-CT were presented in the form of percent change as follows: ΔMTV, ΔTLG, ΔSUV_{max}, ΔHighest SUV_{peak}, ΔTBR ve ΔPleural Thickness. With a threshold of –54.03 for ΔMTV, median OS was 29.9 (95% CI 27.5–32.2) months in patients with ΔMTV ≤ –54.03 and 16 (95% CI 12.4––19.5) months in patients with ΔMTV > –54.03 (p = 0.002) (Fig. 4). When the patients were categorized into two groups: those with ΔTLG below and above –62.58, median OS was 30.9 (95% CI 28–33.7) months in patients with ΔTLG ≤ –62.58 and 16 (95% CI 12.1–19.8) months in patients with ΔTLG > –62.58 (p = 0.001) (Fig. 5). When the patients were analyzed in two groups based on a threshold of 1.84 for TBR2, median OS was 29.9 (95% CI 14–45.7) months in patients with TBR2 ≤ 1.84 and 16 (95% CI 11.2–20.7) months in patients with TBR2 > 1.84 (p = 0.039). Median OS was 29.3 (95% CI 14–44.6) months for patients with SUV_{max1} ≤ 7.95 and 17.1 (95% CI 15.2–19) months for those with SUV_{max} > 7.95 (p = 0.312). Patients with response according to Δpleural thickness had median OS of 29.3 (95% CI 15.6–43) months and those without response had median OS of 17.1 (95% CI 14.8–19.3) months (p = 0.182). Patients' survival analyses are presented in Table 3.

Discussion

Imaging with the use of ^{18}F-FDG PET-CT is a valuable diagnostic modality in patients with mesothelioma and for assessment of treatment response. While SUV_{max} values obtained from ^{18}F-FDG PET-CT have traditionally been used to evaluate treatment response, recently, parameters such as MTV, TLG, highest SUV_{peak}, and pleural thickness have become increasingly important.

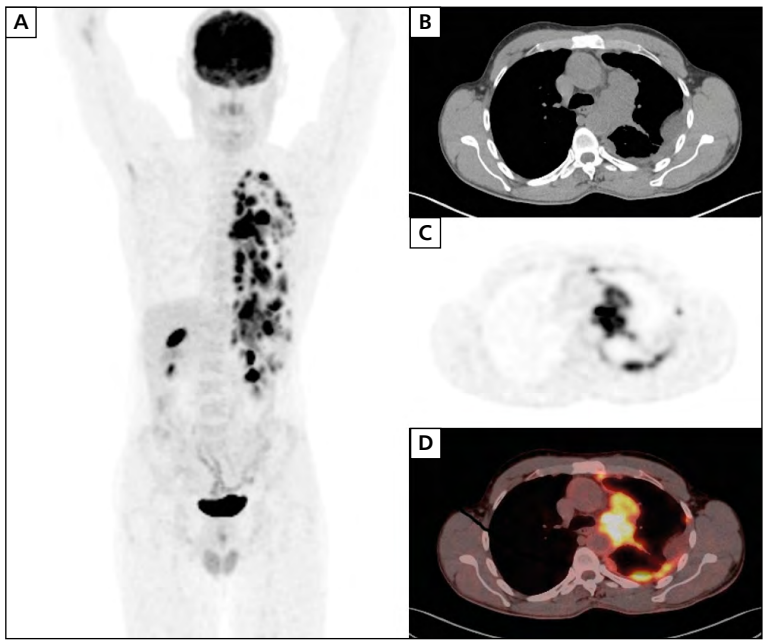

Figure 1. Pre-treatment imaging; **A.** Maximum intensity projection (MIP); **B.** Computed tomography; **C.** Positron emission tomography; **D.** Fusion images

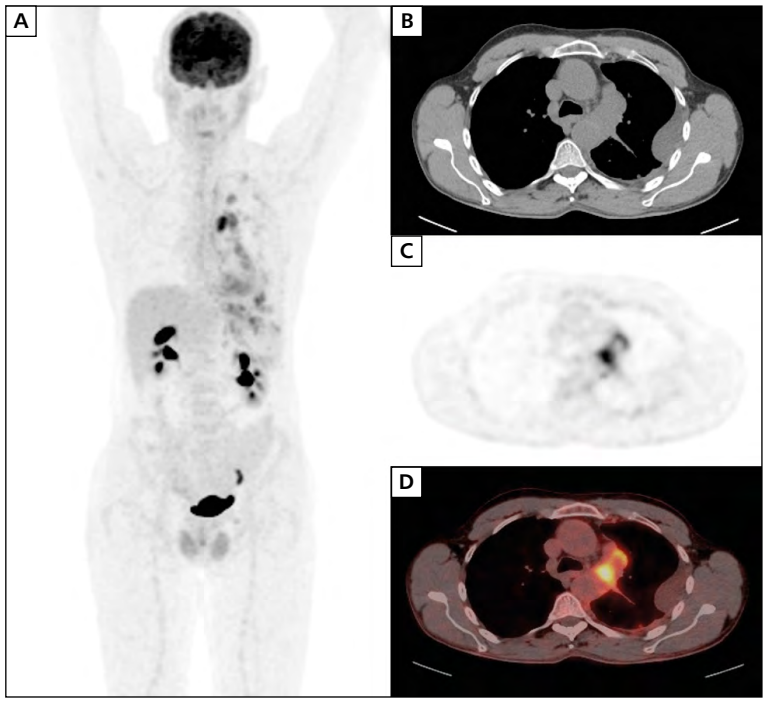

Figure 2. Post-treatment imaging; **A.** Maximum intensity projection (MIP); **B.** Computed tomography; **C.** Positron emission tomography; **D.** Fusion images

In our study, median OS was 29.3 (95% CI 14–44.6) months for patients with $SUV_{max1} \leq 7.95$ and 17.1 (95% CI 15.2–19) months for those with $SUV_{max} > 7.95$ ($p = 0.312$). In line with our results, a study by Schaefer et al. [13] in 2012 including 41 patients did not find a correlation between survival and SUV_{max1} or ΔSUV_{max}. In a 2014 study conducted by Klabatsa et al. [14] in 60 patients, the univariate analysis indicated a hazard ratio of 1.26 (95% CI

Table 2. Sensitivity and specificity ratios and receiver-operating characteristic (ROC) analysis results

Parameters	Cut-off	Sensitivity	Specificity
SUV_{max1}	7.95	63%	62%
TLG2 [mL × cm^3]	158	57%	56%
MTV2 [cm^3]	63.9	57%	62%
ΔMTV [cm^3]	–54.03	68%	68%
ΔTLG [mL × cm^3]	–62.58	73%	75%
ΔHighest SUV_{peak}	–7.27	63%	62%
Highest SUV_{peak2}	4.6	57%	56%
TBR2	1.84	63%	62%
Parameters	**AUC**	**95% CI**	**p-value**
SUV_{max1}	0.69	0.51–0.87	0.049
TLG2 [mL × cm^3]	0.75	0.59–0.91	0.011
MTV2 [cm^3]	0.73	0.56–0.89	0.02
ΔMTV [cm^3]	0.71	0.54–0.88	0.031
ΔTLG [mL × cm^3]	0.76	0.59–0.92	0.009
ΔHighest SUV_{peak}	0.69	0.51–0.88	0.047
Highest SUV_{peak2}	0.71	0.54–0.88	0.03
TBR2	0.72	0.55–0.9	0.022

AUC — area under the curve; CI — confidence interval; MTV — metabolic tumor volume; SUV_{max} — maximum standardized uptake value; TBR — tumor/background; TLG — total lesion glycolysis

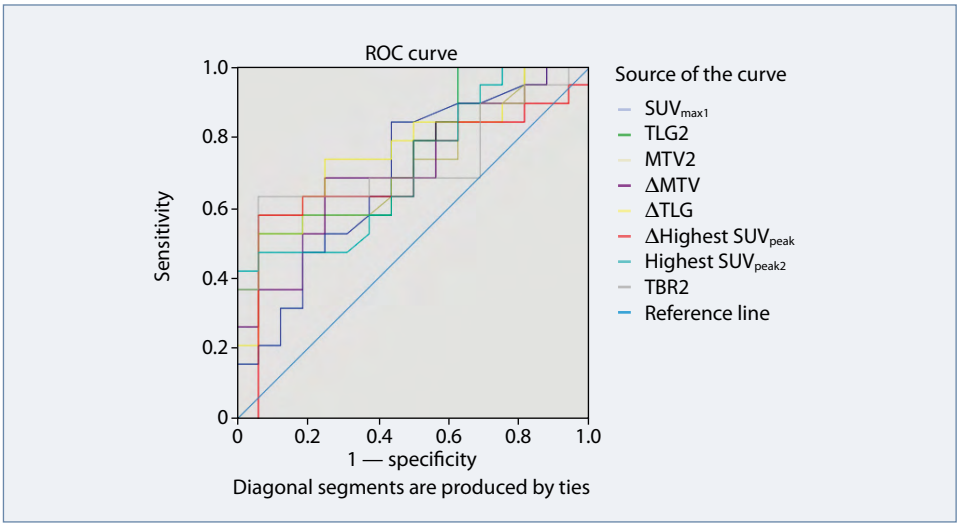

Figure 3. Receiver-operating characteristic (ROC) curve analysis results; MTV — metabolic tumor volume; SUV — standardized uptake value; TBR — tumor/background; TLG — total lesion glycolysis

1.00–1.58) for every 5-unit increase in the SUV_{max1} value ($p = 0.051$). In a 2010 study conducted by Lee et al. [15] in 13 patients, SUV_{max1} was determined as 9.5 ± 4.9 in responsive patients and as 11 ± 6.5 in unresponsive patients ($p = 0.724$). In a 2017 study conducted by Zuccali et al. [16] in 142 patients; the univariate analysis indicated a hazard ratio of 1.1 (95% CI 1.04–1.16) for each unit of increase in the SUV_{max1} value ($p < 0.001$). In the same study, the univariate analysis also determined a hazard ratio of 1.09 (95% CI 1.04–1.15) for every 10-unit increase in ΔSUV_{max} ($p < 0.001$). Moreover, the same study found that higher SUV_{max1} and ΔSUV_{max}

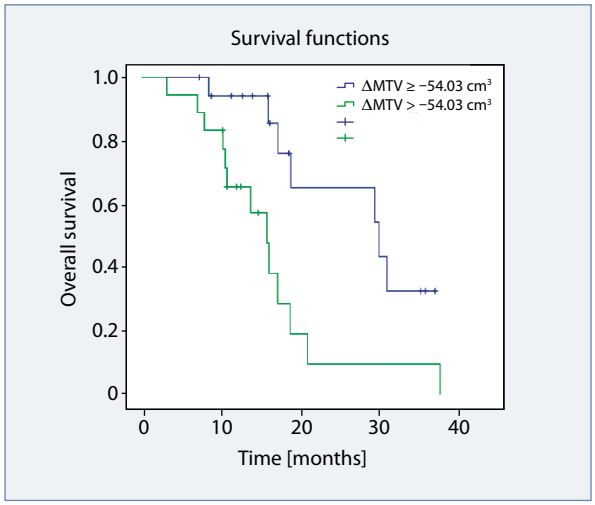

Figure 4. Overall survival results according to Δmetabolic tumor volume (MTV) values; MTV — metabolic tumor volume

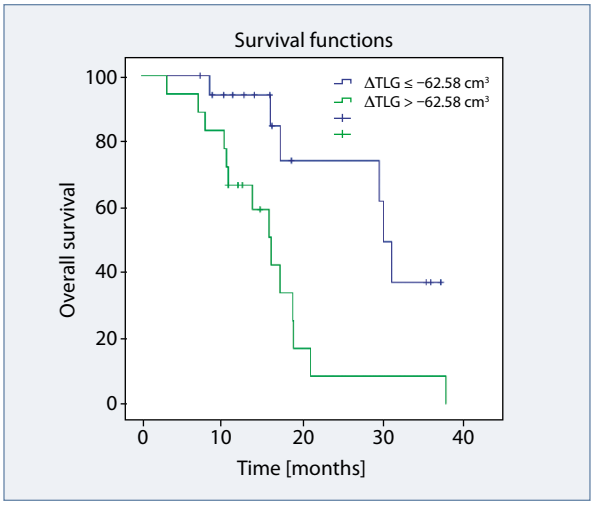

Figure 5. Overall survival results according to Δtotal lesion glycolysis (TLG) values

Table 3. Kaplan-Meier survival analysis results according to parameters

Parameters	mOS [months]	95% CI	p-value
All patients	18.8	13.9–23.6	
TLG2 [mL × cm^3]			0.09
≤ 158	29.9	15.3–44.4	
> 158	16	9.00–23.0	
MTV2 [cm^3]			**0.007**
≤ 63.9	29.9	15.3–44.4	
> 63.9	16	8.9–23	
ΔMTV [cm^3]			**0.002**
< −54.03	29.9	27.5–32.2	
> −54.03	16	12.4–19.5	
ΔTLG [mL × cm^3]			**0.001**
≤ −62.58	30.9	28–33.7	
> −62.58	16	12.1–19.8	
TBR2			**0.039**
≤ 1.84	29.9	14–45.7	
> 1.84	16	11.2–20.7	
SUV_{max1}			0.312
≤ 7.95	29.3	14–44.6	
> 7.95	17.1	15.2–19	
ΔPleural thickness response			0.182
Yes	29.3	15.6–43	
No	17.1	14.8–19.3	

CI — confidence interval; mOS — median overall survival; MTV — metabolic tumor volume; SUV_{max} — maximum standardized uptake value; TBR — tumor/background; TLG — total lesion glycolysis

values were associated with shorter survival times [16]. In a 2013 study conducted by Abakay et al. [10] in 177 patients, median OS was 14 months (95% CI 1.3–16.6) in patients with $SUV_{max1} < 5$ and 10 months (95% CI 8.1–11.8) in patients with $SUV_{max} > 5$ ($p = 0.013$). In a 2006 study conducted by Flores et al. [17] in 137 patients, median OS was 21 months in patients with $SUV_{max} < 10$ and 9.7 months in patients with $SUV_{max} > 10$ ($p = 0.02$). In a 2017 study conducted by Hall et al. [18] in 73 patients, median OS was 17.5 (9–24.5) months in patients with $SUV_{max} < 10.6$ and 8.9 (5.9–16) months in patients with $SUV_{max} > 10.6$ ($p = 0.001$). In the same study, the analysis of 9-week and 9-month PFS revealed higher ΔSUV_{max} values in patients who showed progression than in those who did not [18].

Patients with lower ΔMTV were found to achieve longer survival times in our study. Median OS was 29.9 (95% CI 27.5–32.2) months in patients with $\Delta MTV \leq -54.03$ compared to 16 (95% CI 12.4–19.5) months in patients with $\Delta MTV > -54.03$ ($p = 0.002$). In the study by Hall et al. [18], median OS was 8.8 months (5.9–14.6) in patients with MTV1 > 460 compared to 18.7 months (9.1–24.5) in patients with MTV < 460 ($p < 0.001$). The same study also observed lower ΔMTV values in patients who did not progress compared to those who progressed at the end of a 9-month follow-up period [18]. In the study by Lee et al. [15], patients with lower MTV1 values had longer PFS. The same study found an MTV1 of 70.1 ± 85.4 in responsive patients compared to 676.4 ± 1019.6 in unresponsive patients ($p = 0.045$). In the study by Klabatsa et al. [14], median OS was reported as 6.4 months in patients with MTV > 755 compared to 14.4 months in those with MTV < 755 ($p = 0.001$). Akdeniz et al. [11] also found OS of 24.6 ± 4.1 months in patients with MTV1 < 113 compared to 8.2 ± 1.3 months in those with MTV > 113 ($p = 0.002$).

In our study, we found that higher TLG2 and ΔTLG values were associated with shorter survival times. This is consistent with a study by Zuccali et al. [16], which found median OS of 13.3 months in patients with TLG <534.3 compared to 5.6 months in patients with TLG1 > 534.3 ($p < 0.001$). Median OS was 7.9 months for patients with $\Delta TLG < -30$ compared to 5.6 months in patients with $\Delta TLG > -30$ ($p < 0.001$). In the study by Francis et al. [12], a hazard ratio of 0.7 (95% CI 0.58–0.90) was determined for every 10-unit increase in ΔTLG ($p = 0.008$). In the study by Klabatsa et al. [14], median OS was 6.4 months in patients with TLG1 > 2.914 ml compared to 18.1 months in those with TLG1 < 2.914 ($p < 0.001$). Similarly, the study by Lee et al. [15] also observed shorter survival times in patients with higher TLG1 levels ($p = 0.009$). The same study also determined TLG1 levels of 389.2 ± 492.9 in responsive patients compared to levels of 2666.7 ± 4122.7 in unresponsive patients ($p = 0.093$) [15]. In the study by Akdeniz et al. [11], patients with TLG1 < 419.5 had OS of 22.4 ± 4.2 and patients with TLG > 419.5 had overall survival of 8.5 ± 1.3 ($p = 0.008$).

When evaluated with respect to Δpleural thickness, there was no statistically significant difference between the patients in terms of survival. According to the results of a 2017 study conducted by Kanemura et al. [19] in 82 patients that compared the mRECIST criteria evaluated based ^{18}F-FDG PET-CT on CT results and, ^{18}F-FDG PET-CT was found to be superior in the evaluation of treatment response and prediction of PFS. On the other hand, in the study by Schafer et al. [13], mRECIST evaluation was found to be superior although MTV and TLG obtained by ^{18}F-FDG PET-CT were statistically significant in the prediction of survival.

The limitations of our study include small sample size, heterogeneity of patient groups, and the retrospective nature of the study.

Conclusions

Although there are studies in which metabolic parameters such as SUV_{max1} and ΔSUV_{max} were associated with survival, these parameters were not found to be statistically significant OS predictors. On the other hand, our study and other studies in the literature have determined that volumetric parameters such as ΔMTV and ΔTLG are statistically significant OS predictors. Accordingly, it can be stated that volumetric parameters obtained from ^{18}F-FDG PET-CT are more valuable than metabolic parameters in the prediction of survival. More studies on this matter are needed for this result to receive general acceptance and enter clinical use. In addition, ^{18}F-FDG PET-CT was found to be superior to CT in certain studies that compared the two modalities, and volumetric parameters were found to be superior to pleural thickness in our study. However, more studies on this topic are warranted.

Article Information and Declarations

Data availability statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethics statement

Ethical approval was obtained for this study from Dicle University, Faculty of Medicine Non-Invasional Clinical Research Ethics Committee (date: 12.05.2022, approval number: 133).

All analyses were performed in accordance with the principles of the Declaration of Helsinki.

Author contributions

All authors: consept, design, supervision, fundings, materials, data collection and/or processing, analysis and/or interpretation, literature review, writing, critical review.

Funding

This study was not supported by any organization or entity. The authors have no financial involvement with any organization or entity. No writing assistance was utilized in the production of this manuscript.

Acknowledgments

None to declared.

Conflict of interest

The authors declare no conflict of interest.

Supplementary material

None.

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