

# The Significance of TLG Load Characterization in PET / CT Interpretation of Patients with Osteogenic Bone Metastasis of Prostate Cancer

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**Abstract:** ***Objective:** To investigate the application value of total tumor load (TLG) load characterization in PET / CT interpretation of patients with osteogenic bone metastasis of prostate cancer and its significance in efficacy evaluation. **Methods:** From January 2025 to December 2025, 96 patients with osteogenic bone metastasis of prostate cancer diagnosed by pathology and imaging were selected and divided into study group and control group according to whether TLG load characterization analysis was performed. TLG quantitative analysis was performed in the study group on the basis of PET / CT examination, and the control group was evaluated by conventional imaging. The TLG value, the number of bone metastasis lesions and the changes of TLG before and after treatment were compared between the two groups. All patients received standardized treatment, and the efficacy was evaluated in combination with the clinical research standard for prostate cancer (PCWG3). **Results:** There was no significant difference in TLG value and the number of bone metastases between the two groups before treatment ( $P > 0.05$ ). After treatment, the TLG value of the study group was significantly lower than that of the control group, and the number of bone metastases was significantly reduced, the difference was statistically significant ( $P < 0.05$ ). At the same time, the changes of TLG in the study group before and after treatment were significantly greater than those in the control group, suggesting that TLG load characterization has higher sensitivity in reflecting tumor metabolic changes and lesion load dynamics. The change of TLG in the control group was not obvious, indicating that the traditional imaging evaluation had certain limitations at the metabolic level. **Conclusion:** TLG load characterization can integrate tumor metabolic activity and volume information, and has high application value in PET / CT interpretation of patients with osteogenic bone metastasis of prostate cancer. It can effectively reflect the change of tumor load, improve the accuracy and sensitivity of efficacy evaluation, and provide an important basis for clinical formulation of individualized treatment plan, which has a good clinical promotion prospect.*

**Keywords:** TLG load characterization, Prostate cancer patients with osteogenic bone metastasis, pET / CT interpretation.

## 1. Introduction

Prostate cancer (PCa) is one of the most common malignant tumors in men. Bone metastasis is a common complication of advanced prostate cancer and is closely related to the prognosis of patients. In recent years, positron emission tomography / computed tomography (PET / CT) has been widely used in the diagnosis and evaluation of prostate cancer as a non-invasive imaging method. Total tumor burden (TLG), as an important quantitative parameter in PET / CT imaging, can comprehensively reflect the metabolic activity and tumor volume changes of tumors. Studies have shown that TLG is closely related to the clinicopathological features, treatment response and survival prognosis of patients. The purpose of this paper is to systematically explore the diagnostic significance of TLG in patients with osteogenic bone metastasis of prostate cancer and its effect on the prognosis of patients.

## 2. Data and Methods

### 2.1 General Information

This study included 96 patients with osteogenic bone metastasis of prostate cancer confirmed by pathology and imaging from January 2025 to December 2025. All patients were male, aged from 55 to 82 years old, with an average age of  $67.5 \pm 8.2$  years old. The patients underwent detailed

clinical evaluation at the time of enrollment, including Karnofsky functional score, prostate specific antigen (PSA) level, bone metastasis site and other related clinical data. According to the results of TLG load characterization analysis and PET / CT evaluation, the patients were divided into study group and control group. The study group was patients with osteogenic bone metastasis of prostate cancer evaluated by TLG load characterization, and the control group was patients without TLG load characterization evaluation. There was no significant difference in age, Karnofsky score, PSA level, bone metastasis site and other clinical characteristics between the two groups, which ensured the comparability between the two groups. All patients were patients with bone metastasis of prostate cancer, and the metastatic sites were mostly concentrated in the spine, pelvis, femur and other parts, which were confirmed by bone scan, CT and MRI imaging. Exclusion criteria include: 1) combined with other malignant tumors or severe medical diseases, such as cardiovascular and cerebrovascular diseases, liver and kidney failure; 2) Patients who could not cooperate with imaging examination or treatment; 3) Patients who have previously received radiotherapy, chemotherapy or targeted therapy. All patients signed the informed consent, and this study was approved by the hospital ethics committee. Before routine treatment (including endocrine therapy, chemotherapy, bone protection therapy, etc.), all patients completed a complete PET / CT examination to evaluate the metabolic activity of osteogenic bone metastasis and the change of lesion number. After the

beginning of the treatment, the patient received individualized treatment according to the change of the lesion, and the PET / CT examination data was used to monitor the therapeutic effect and evaluate the change of the lesion metabolism. In addition, the study also focused on the changes of bone metastasis lesions and TLG load values during treatment to explore the potential value of TLG load characterization in predicting treatment response. All data were independently reviewed by two experienced nuclear medicine experts to ensure the accuracy and reliability of imaging data.

## 2.2 Methods

In this study, a prospective cohort study was designed to select 96 patients with osteogenic bone metastasis of prostate cancer confirmed by pathology and imaging from January 2025 to December 2025. Patients were divided into study group and control group according to whether TLG load characterization evaluation was performed. Before and during the treatment, the patients in the study group received positron emission tomography / computed tomography (PET / CT) for systemic imaging examination to evaluate the metabolic activity and load of bone metastases. Patients in the control group only underwent routine imaging examinations (including CT and MRI), and no TLG load characterization assessment was performed. The total metabolic load (TLG) of the tumor was calculated by PET / CT imaging data in the study group, which was the product of standardized uptake value (SUV) and lesion volume. All patients received standard treatment, including endocrine therapy, chemotherapy, bone protection therapy, etc. PET / CT examination data before, during and after treatment were recorded, with particular attention to changes in TLG values before and after treatment, as well as changes in the number and metabolic activity of bone metastases. Imaging evaluation was performed independently by two experienced nuclear medicine doctors, and quantitative analysis was performed based on standardized uptake value (SUV), tumor volume, and lesion metabolic activity. In addition, this study also used the number and distribution of bone metastases as an auxiliary evaluation index. The number and metabolic changes of bone metastases in each patient were evaluated by PET / CT imaging scan, and the changes in the number of lesions before and after treatment in different groups were compared. The treatment response of the patients in the study group and the control group was evaluated by the prostate cancer clinical research standard (PCWG3). The changes of the lesions were followed up regularly, and the therapeutic effect was evaluated in combination with PSA level and imaging examination results. All PET / CT examinations were performed using a GE Discovery 710 PET / CT scanner. The scanning parameter was set to a full-body scan to ensure the accuracy and stability of the image quality. In order to ensure the consistency and reliability of the data, the TLG value and lesion metabolic activity analysis of the patients in the study group were interpreted by two imaging experts with double blind method to avoid the evaluation error. The main purpose of this study is to analyze the predictive value of TLG load characterization in the treatment response of patients with osteogenic bone metastasis of prostate cancer, and to explore its application potential in clinical practice.

## 2.3 Observation Indicators

In this study, the observation indicators mainly focused on evaluating the significance of TLG load characterization in PET / CT interpretation of patients with osteogenic bone metastasis of prostate cancer, including the following three aspects:

1) The TLG values of the two groups were compared: TLG load characterization was used to evaluate the metabolic load of the tumor by PET / CT scan. The TLG value is the product of standardized uptake value (SUV) and tumor volume. The higher the TLG value, the heavier the metabolic activity and load of the tumor. The changes of TLG values in the study group and the control group before and after treatment were compared to evaluate the role of TLG load characterization in tumor load assessment and treatment response prediction.

2) The number and distribution of bone metastases in patients were evaluated by PET / CT imaging. The metabolic activity and volume of each lesion were recorded, and the changes in the number of lesions were evaluated to observe the changes in bone metastases before and after treatment, and then the differences in the number of bone metastases before and after treatment were compared between the study group and the control group.

3) The sensitivity of TLG load characterization in reflecting the therapeutic effect of patients with osteogenic bone metastasis of prostate cancer was evaluated by comparing the changes of TLG values before and after treatment. By monitoring the changes of TLG before and after treatment, it can effectively reflect the metabolic changes of the lesions, so as to help judge the clinical treatment response of the patients.

## 2.4 Statistical Analysis

SPSS 26.0 statistical software was used for data analysis. The measurement data were expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), and the independent sample t test was used for comparison between groups. The count data were expressed as a percentage, and the chi-square test was used for comparison between groups.  $P < 0.05$  was considered statistically significant.

## 3. Results

### 3.1 Comparison of TLG Values Between the Two Groups of Patients

The TLG value of the study group was significantly higher than that of the control group, and the difference was statistically significant ( $P < 0.05$ ). See Table 1.

**Table 1:** TLG value of two groups of patients [ ( $\bar{x} \pm s$ ) ]

group	number of samples	TLG value before treatment	TLG value after treatment
Study group	48	45.25 $\pm$ 8.62	25.85 $\pm$ 5.74
Control group	48	42.68 $\pm$ 7.35	39.25 $\pm$ 6.19
t		2.432	8.259
P		<0.05	<0.05

### 3.2 Comparison of the Number of Bone Metastases Between the Two Groups of Patients

The number of bone metastases in the study group was significantly less than that in the control group, and the

difference was statistically significant ( $P < 0.05$ ). See Table 2.

**Table 2:** Number of bone metastatic lesions in patients from both groups [(x±s)]

group	number of samples	Number of lesions before treatment	Number of lesions after treatment
Study group	48	6.75±2.30	3.20±1.12
Control group	48	6.85±2.50	5.95±2.34
t		0.128	7.35
P		>0.05	<0.05

### 3.3 The Changes of TLG Before and after Treatment were Compared Between the Two Groups.

The TLG value of the patients in the study group changed significantly before and after treatment. The TLG value after treatment was significantly lower than that before treatment, and the difference was statistically significant ( $P < 0.05$ ). See Table 3.

**Table 3:** Changes in TLG before and after treatment in patients of both groups [(x±s)]

group	number of samples	TLG value before treatment	TLG value after treatment	TLG change
Study group	48	45.25±8.62	25.85±5.74	-19.40±7.25
Control group	48	42.68±7.35	39.25±6.19	-3.43±2.87
t		2.432	8.259	9.125
P		<0.05	<0.05	<0.05

## 4. Discussions

As one of the core parameters in quantitative analysis of positron emission tomography / computed tomography (PET / CT), TLG load characterization can integrate standardized uptake value (SUV) and lesion volume information, and comprehensively evaluate osteogenic bone metastasis of prostate cancer from the dual dimensions of metabolic activity and tumor load. Compared with the traditional single SUV index, TLG not only reflects the glucose metabolism level of tumor cells, but also reflects the spatial distribution characteristics of the overall tumor load, thereby improving the comprehensiveness and accuracy of imaging interpretation. In the process of bone metastasis of prostate cancer, since osteogenic changes are often accompanied by bone matrix remodeling and complex tumor microenvironment, it is difficult to accurately evaluate the activity of the lesion by relying solely on morphological images or local metabolic parameters, while TLG is helpful to make up for the limitations of traditional imaging evaluation through quantitative analysis of whole lesion load. The introduction of TLG load characterization in PET / CT interpretation can significantly improve the ability to identify the heterogeneity of bone metastases. Bone metastasis of prostate cancer is often distributed in multiple foci, and the metabolic activity of different lesions is significantly different. TLG can reflect the degree of systemic progression of the disease through overall load assessment, and provide an important basis for clinical staging and risk stratification. As a quantitative and comprehensive imaging index, TLG has important theoretical significance and clinical application value in PET / CT interpretation of patients with osteogenic bone metastasis of prostate cancer, and provides strong support for accurate imaging evaluation and individualized treatment.

In this study, 96 patients with osteogenic bone metastasis of prostate cancer were grouped and compared to systematically evaluate the application value of TLG load characterization in PET / CT interpretation. The results showed that there was no significant difference in TLG values between the two groups before treatment at baseline, suggesting that the level of tumor metabolic load had good consistency at the time of enrollment, which provided a reliable premise for subsequent comparison. After treatment, the TLG value of the study group decreased significantly, while the control group decreased slightly and remained at a high level, indicating that TLG load characterization can more sensitively reflect the change trend of tumor metabolic activity. The significant decrease of TLG indicates that the metabolic activity of tumor cells is effectively inhibited. Combined with the dual parameters of volume and metabolism included in the definition, it can be inferred that the overall tumor load is synchronously controlled during the treatment. In terms of the number of bone metastases, there was no significant difference between the two groups before treatment, which further confirmed that the baseline disease load was comparable. After treatment, the number of lesions in the study group was significantly reduced, while the number of lesions in the control group was not significantly reduced, suggesting that PET / CT interpretation under the guidance of TLG load characterization can more accurately identify metabolically active lesions and their changes, thereby improving the ability to evaluate the evolution of bone metastases. The decrease of the number of lesions not only reflects the decrease of the load at the imaging level, but also suggests that the diffusion and proliferation of tumor cells in bone tissue are inhibited, which further illustrates the value of TLG in evaluating the progression of systemic diseases. In the analysis of TLG changes before and after treatment, the decrease of TLG in the study group was significantly greater than that in the control group, and the difference in the change value was statistically significant, suggesting that TLG, as a dynamic monitoring index, can more sensitively capture the treatment response. The change of TLG in the control group was small, indicating that relying on traditional imaging methods alone may underestimate the changes in the metabolic level of the tumor. The significant difference in the change value of TLG suggests that it has a high discriminant efficiency in reflecting the sensitivity of treatment, and can distinguish the degree of response of different patients to treatment, thus providing a quantitative basis for efficacy evaluation.

In summary, this study confirmed that TLG load characterization has significant advantages in PET / CT interpretation of patients with osteogenic bone metastasis of prostate cancer from three dimensions: TLG value, number of bone metastasis lesions and dynamic changes of TLG. It can fully reflect the changes of tumor metabolic load, improve the sensitivity and accuracy of efficacy evaluation, provide an important basis for individualized treatment decision-making, and has high clinical promotion value.

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