

Effectiveness of Systemic Immune-Inflammatory Index in Predicting Bone Metastasis in Newly Diagnosed Prostate Cancer Patients

Rilian Song¹, Gaomeng Wei^{2,*}, Baode Lu², Dingxi Jian¹, Zilu Zhang¹

¹ Graduate College of Youjiang Medical College for Nationalities, Baise, Guangxi, 533000, China

² Department of Urology, Affiliated Hospital of Youjiang Medical College for Nationalities, Baise, Guangxi, 533000, China

* Corresponding author: Gaomeng Wei

Abstract: Objective To explore the effectiveness of systemic immune inflammation index (Systemic immune-inflammation index, SII) in predicting bone metastasis in patients with newly diagnosed prostate cancer (Prostatic cancer, PCa). Methods The retrospective analysis of 200 cases of prostate cancer from January 2020 to June 2023 and 70 cases of bone metastasis compared the expression difference of SII between the two groups and analyzed the clinical diagnostic value of SII in prostate cancer bone metastasis. The resulting SII in the bone metastasis group was 500.63(351.24-696.57) 10⁹/L, the SII in the no-bone metastasis group was 350.12(258.41-529.40) 10⁹/L, statistically significant, P < 0.05. The ROC curve analysis revealed that its sensitivity was 68.63% and its specificity was 60.95%. Conclusion System immune inflammation index (SII) has certain application value for bone metastasis in patients with newly diagnosed prostate cancer (PCa), and high level of SII indicates poor prognosis, which is worth further clinical study.

Keywords: Prostate Cancer; Systemic Immune Inflammation Index; Bone Metastasis.

1. Introduction

Prostate cancer (PCa) in the male tumor incidence, second only to lung cancer, is one of the most common malignant tumors of male urogenital system, in Europe and the United States and many other western countries, PCa in the male population incidence of malignant tumor in the first, mortality in third, in China male incidence of sixth, mortality in seventh[1]. Compared with developed countries such as Europe and the United States, although the incidence of PCa in China is relatively low, the incidence and mortality rate are increasing year by year with the extension of average life expectancy in China, the aggravation of population aging, as well as the progress of PCa early screening and diagnosis technology[2, 3]. It is expected that the incidence and mortality of PCa in China will continue to rise from 2020 to 2030. By 2030, the crude incidence of PCa in China is 38.99/10 million and the crude mortality rate is 10.41/10 million, which has posed a serious threat to the health problems of elderly men in China and brought heavy economic burden[4]. Because patients with early prostate cancer have no typical clinical symptoms, once block the urethra or invade the bladder neck with the lump, can be accompanied by lower urinary tract symptoms, including urinary incontinence, hematuria, urinary retention and other conditions [1]. Clinical studies indicate that prostate tumors are usually located in the peripheral zone of the prostate, and if the clinical diagnosis is known that the tumor volume is not less than 0.2ml, they may have prostate cancer[2]. Clinical studies show that the inflammatory status and internal environment changes of malignant tumors will have a certain impact on the prognosis and outcome of the disease, and there is a certain correlation between the inflammatory status, tumor malignancy degree and prognosis. Patients with prostate cancer have a high morbidity and mortality. At present, the new cases of prostate cancer in China are still

increasing year by year. Most of the diseases are in the advanced stage when diagnosed, accompanied by bone metastasis [3]. Therefore, if the lesions can be identified in time and bone metastasis can be predicted early, the prognosis of patients may be improved. Therefore, this study mainly analyzed the effectiveness of systemic immune inflammation index (SII) in predicting bone metastasis in patients with newly diagnosed prostate cancer (PCa).

2. Data and Methods

2.1. General Information

A retrospective analysis of 200 prostate cancer patients to our hospital from January 2020 to June 2023, including 70 in the bone metastasis group and 130 in the no bone metastasis group.

Inclusion criteria: Pathologic diagnosis of prostate cancer; complete clinicopathological data; informed consent for inclusion in this study.

Exclusion criteria: infection and anti-infection treatment in last 7d; anticoagulation therapy and antiplatelet aggregation therapy in last 7d; malignant tumors, blood diseases, abnormal liver and kidney function, autoimmune diseases, immunotherapy and radiotherapy and chemotherapy; recent transfusion therapy; withdrawal.

2.2. Methods and Study Indicators

Baseline data from both groups were analyzed. Within 7d before puncture, 5ml of early morning fasting venous blood samples were collected, and automatic biochemical analyzer (Roche Hitachi, model 7600) was used to calculate SII, analyze the difference of relevant indicators, and the ROC curve results of SII were analyzed.

2.3. Statistical Treatment

The relevant data of both groups were included in the

statistical software of SPSS19.0, and the count data were expressed by [n (%)] and the chi-square test χ^2 Represents, measurement data by (\pm S), T test, P <0.05 is statistically significant. $\bar{\chi}$

3. Results

3.1. Comparison of the Baseline Data Between the Two Patient Groups

The SII comparison differences between patients with and without bone metastasis were statistically significant, P <0.05. See Table 1.

Table 1. Comparison of baseline data between the two groups of prostate cancer patients

metric	Bone metastasis group (n=70)	Group with no bone metastases (n=130)	Z/ X ²	P
Age (year)	68(65-74)	67(63-75)		
Gleason Score				
Admidia 6 points	1	21	17.632	<0.001
7 Points	19	56		
Admito 8 points	50	53		
T by stages				
T1 stage	1	31	15.620	<0.001
T2 stage	13	49		
T3 stage	26	34		
T4 stage	30	16		
SII(\times 109/L)	500.63(351.24-696.57)	350.12(258.41-529.40)	12.365	<0.001

3.2. The ROC Curve Analysis of Bone Metastasis Prediction by SII

See Table 2 and Figure 1 below for more details.

Table 2. ROC curve analysis of bone metastasis prediction by SII

metric	cutoff value	AUC/(%, 95% CI)	Sensitivity / (%, 95% CI)	Specific / (%, 95% CI)	Youden index
SII	410.56	0.675(0.620-0.731)	68.63(58.24-77.12)	60.95(53.71-67.85)	0.296

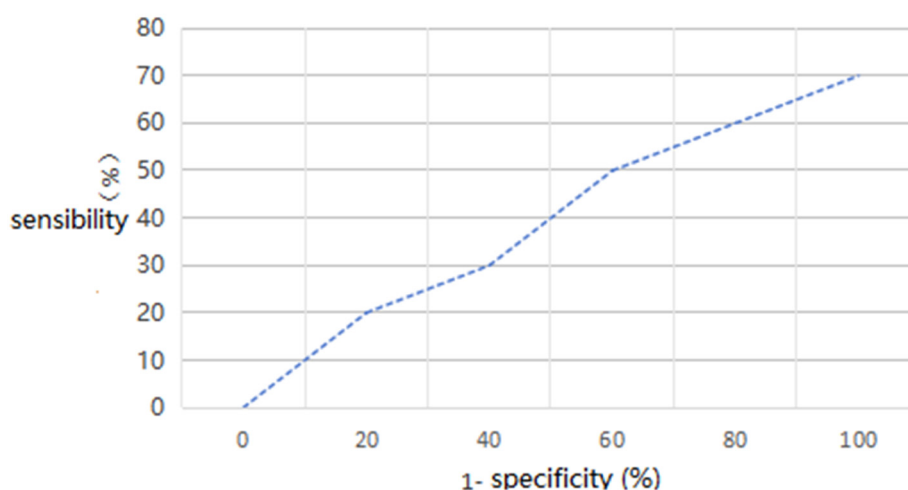


Figure 1. ROC plot of SII for bone metastasis prediction

4. Discussion

At present, the specific etiology and pathogenesis of bone metastasis in PCa patients have not been thoroughly clarified, and it is generally believed that it may be related to genetic

inheritance, dietary structure and external environment. Once patients develop bone metastasis, it can lead to a series of related diseases such as bone pain and pathological fracture, and then have a negative impact on the patients quality of life and life cycle [4]. Research data show that once PCa patients develop bone metastasis, they will increase the risk of death,

and the death risk is about 50% higher than that of patients with lymph node metastasis[5]. Clinical practice has found that patients with early PCa bone metastasis have no typical symptoms, and patients generally seek medical treatment after the appearance of obvious bone pain symptoms, which leads to the loss of the best treatment time and leads to poor prognosis[6]. Therefore, how to effectively diagnose bone metastasis in PCa patients is of important significance. Whole body bone scan is an important means to diagnose bone metastases at present, which has certain advantages compared with conventional X-ray examination, but its standard for screening for PCa is still controversial. Distant metastasis of prostate cancer is the most common bone metastasis, and it is also one of the main causes of death in patients.

SII is based on neutrophils, platelets and lymphocytes in routine blood tests, which is economical and simple clinically. Neutrophils are important inflammatory cells in the body, which can be divided into two types in patients with tumor. They are N1 in the early tumor, which engulf and secrete inflammatory mediators. After the tumor enters the tumor microenvironment, the phenotype and function will change. Platelets are an important part of the bodys coagulation system. In tumor patients, it and tumors will promote each other, forming a malignant cycle. Tumor cells and tumor stromal cells will secrete platelet production factors and activation factors, promoting the generation and activation of platelets, and there are a large number of angiogenic regulatory proteins in platelets, which can promote the generation of tumor neovascularization, thus accelerating the proliferation and invasion of tumor cells. Lymphocytes are the main executor of immune function. Due to the high metabolic consumption of long-term tumors, malnutrition and low immunity, the longer the course of the disease, the later the disease, these clinical manifestations may become more obvious, to the advanced stage Cachexia may occur. Thus, elevated neutrophils and platelets and decreased lymphocytes together contribute to the increased SII levels in tumor patients. The high level of SII indicates that tumor patients are in a high level of uncontrollable tumor-related inflammation, while the immune function is also suppressed, and such patients have rapid tumor progression and prognosis [7]. A total of 200 patients with prostate cancer were included in the study, 70 in the bone metastasis group and 130 in the no bone metastasis group, to analyze the effect of SII on bone metastasis of prostate cancer. It was known that the SII in the bone metastasis group was $500.63(351.24-696.57) 10^9/L$, the SII in the no-bone metastasis group was $350.12(258.41-529.40) 10^9/L$, the comparative difference was statistically significant, $P < 0.05$, indicating that a high level of SII predicted a poor prognosis, compared with Zhang Zhiyu et al [8] The conclusions of the study match.

Nowadays, prostate cancer has become the most common malignant tumor in the male urinary system in China. In recent years, with the improvement of peoples living standards and the extension of life expectancy and the accelerated aging process of the social population, the prevalence of prostate disease has increased year by year. As one of the malignant tumors with extremely high incidence and heterogeneity, the early development of prostate cancer is relatively slow, with few corresponding symptoms and a long natural course. With the increasing degree of clinical awareness of prostate disease and the continuous progress of medical technology, more and more people begin to pay attention to and pay attention to prostate cancer in recent years.

Currently, surgery is one of the most effective treatments. For advanced patients, the opportunity of surgery or radiotherapy is generally lost, which seriously affects the quality of life of patients. Therefore, how to improve the quality of life of patients with advanced prostate cancer has become an important topic in the field of medical research. The number of new advanced prostate cancer diagnosis in China is significantly more than that in European and American countries, which seriously affects the diagnosis and treatment quality of prostate cancer patients in China. Therefore, how to improve the level of diagnosis and treatment of prostate cancer has become a problem to be solved at this stage. At present, most diagnostic criteria for prostate cancer are still based on prostate biopsy. PSA was considered the key finger in determining the puncture Standard, its false positive condition can cause clinical excessive puncture of the prostate. Although many new technologies with higher diagnostic specificity and sensitivity have been found, they have not been widely used in clinical practice in terms of convenience, economy and implementation difficulty in practical conditions. Therefore, exploring a new prostate cancer biological marker is very important for the diagnosis and treatment of early prostate cancer. This study aims to investigate the characteristics of early prostate cancer and explore the application of the novel immune inflammation index SII in the diagnosis of prostate cancer.

Inflammatory mediators and cellular effectors are important components of the local tumor environment, and the interaction between the local immune response and the systemic inflammatory status is closely related to the occurrence and development of tumors. There are experimental studies proving that inflammation may increase the risk of developing cancer, and the inflammatory response plays a decisive role in the different stages of tumor initiation, development, angiogenesis, malignant transformation, invasion and metastasis. In addition, a more severe inflammatory state is induced by the release of certain cytokines during the tumor development, indicating that the local or systemic immune inflammatory response is closely related to the survival prognosis of the tumor. Therefore, inflammation-related indicators are effective markers to predict tumor prognostic factors. In actual practice, measuring the total blood cell count of lymphocytes, neutrophils, platelets in peripheral blood are a simple and useful way to understand the state of systemic inflammatory response. In conclusion, neutrophils, lymphocytes, and platelets play a crucial role in tumor-associated inflammation and immunology, and their levels have significant prognostic value. The influence of immune inflammatory cells on tumor progression and patient prognosis has been demonstrated in a variety of solid tumors. According to the RUANE-MCATEER EIMEAR et al[9] Studies have shown that the neutrophil lymphocyte ratio (NLR) and the platelet lymphocyte ratio (PLR) are closely related to the prognosis of various malignancies and other tumors. However, PLR, NLR integrate only two of these types of inflammatory cells, and their prognostic ability is often defective. Systemic immune inflammation index (SII), defined as neutrophil platelet count lymphocyte count [(neutrophil platelet count / lymphocyte count), based on lymphocyte count (L), neutrophil count (N) and platelet count (P), has been used to evaluate the balance between preoperative inflammation and immune status, has been proved to be an important prognostic factor for survival prognosis and recurrence of hepatocellular carcinoma, germ

cell tumor, bladder cancer, and other malignant tumors, and may be better than other inflammatory indicators [10].

In conclusion, the systemic immune inflammation index (SII) has certain application value for bone metastasis in patients with newly diagnosed prostate cancer (PCa), and the high level of SII indicates poor prognosis, which deserves further in-depth clinical study.

Acknowledgments

Project name: The expression of MRE 11 in prostate cancer and its influence on the proliferation and invasion capacity of prostate cancer cells;

Funding category: High-level Talents of Affiliated Hospital of Youjiang Medical College for Nationalities (Contract No.: Y202011706).

References

- [1] Liang Anshi, Xie Caiye. Predictive value of systemic immune inflammatory nutrition index in elderly patients undergoing laparoscopic radical prostate cancer [J]. Chinese Sex Science, 2023,32 (11): 30-34.
- [2] Shi Jiahao, Chen Chunyang, Wang Zhirong, et al. Prediction of systemic immune inflammation index versus monocyte-lymphocyte count for biochemical recurrence after prostate cancer surgery [J]. International Journal of Urology, 2023,43 (6): 1010-1015.
- [3] Man Yanan, Chen Yanfang. Impact of systemic immune inflammation index and serum albumin on patients with castration-resistant prostate cancer treated with first-line docetaxel [J]. Chinese Journal of Metastatic Oncology, 2022,05 (3): 209-214.
- [4] Gao Jun, Song Weijie, Liu Xianghu, et al. Predictive value of systemic immune inflammation index for bone metastases in first diagnosed prostate cancer patients [J]. Chinese Journal of Urology, 2021,42 (10): 752-757.
- [5] Pan Zhengbo, Cheng Weisong, Cai Hairong, et al. Correlation between preoperative systemic immune inflammation index and prognosis of patients after high-risk / extremely high-risk prostate cancer [J]. Chinese Modern Doctor, 2020,58 (13): 49-52,56.
- [6] Liu Hongbo, Xiao Hongxia, Tian Yuting. Diagnostic value of combining PSA and NTx and D-D index for bone metastasis in prostate cancer [J]. Health Engineering of China, 2022,21 (6): 1035-1037,1040.
- [7] Wang Yongxiang, Zhao Xinghua, Xu Changbao, et al. Risk factor analysis and prediction model establishment of bone metastasis in first diagnosed prostate cancer [J]. Medical Information, 2023,36 (11): 16-20.
- [8] Zhang Zhiyu, Song Zhen, Zhou Qi, et al. Predictive value of preoperative inflammatory markers for clinically meaningful prostate cancer in patients with PI-RADS score 3 [J]. Journal of Dalian Medical University, 2023,45 (3): 198-203,209.
- [9] RUANE-MCATEER EIMEAR, PORTER SAM, OSULLIVAN JOE, et al. Investigating the psychological impact of active surveillance or active treatment in newly diagnosed favorable-risk prostate cancer patients: A 9-month longitudinal study[J]. Psycho-Oncology: Journal of the Psychological Social and Behavioral Dimensions of Cancer,2019,28(8):1743-1752.
- [10] IARROBINO, NICK A, GILL, et al. Early Exploratory Analysis for Patient-reported Quality of Life and Dosimetric Correlates in Hypofractionated Stereotactic Body Radiation Therapy (SBRT) for Low-risk and Intermediate-risk Prostate Cancer: Interim Results from a Prospective Phase II Clinical Trial[J]. American Journal of Clinical Oncology: Cancer Clinical Trials,2019,42(11):856-861.