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ORIGINAL RESEARCH

Association and predictive value of SII, SIRI and CD4/CD8 ratio with acute onset of bronchial asthma

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Abstract

Background: To analyze the correlation between Systemic immunoinflammatory index (SII), Systemic inflammatory response index (SIRI), Cluster of Differentiation 4^+ T cells to Cluster of Differentiation 8^+ T cells ($CD4^+/CD8^+$) ratio and children with acute attack of bronchial asthma, as well as the prognostic value. **Methods**: A total of 98 children with bronchial asthma admitted to our hospital from January 2020 to February 2024 were retrospectively collected. Another 50 healthy children who underwent physical examination in our hospital during the same period were selected as the control group. General data of all subjects were collected. SII, SIRI and $CD4^+/CD8^+$ ratio were collected and calculated. All the bronchial asthma children were treated with aerosol inhalation of glucocorticoids after admission. After 28 days of treatment, the patients were divided into well-controlled group and poor-controlled group. Among all the 98 patients, 65 patients were well prognosis and 32 patients were poor prognosis. **Results**: SII and SIRI in the disease group were significantly higher than those in the control group ($p < 0.05$), and $CD4^+/CD8^+$ was significantly lower p than that in the control group ($p < 0.05$). SII and SIRI in the poor prognosis group were significantly higher than those in the good prognosis group ($p < 0.05$), and $CD4^+/CD8^+$ was significantly lower than those in the good prognosis group ($p < 0.05$). **Conclusions**: SII, SIRI and $CD4^+/CD8^+$ are closely related to children with acute attack of bronchial asthma. These indicators deserve further attention in clinical practice.

Keywords

SII; SIRI; CD4/CD8 ratio; Bronchial asthma

1. Introduction

Bronchial asthma is a common chronic respiratory inflammatory disease in children. Its main characteristics are airway inflammation or hyperresponsiveness, and its clinical manifestations are shortness of breath, wheezing, cough, chest tightness, *etc.*, which has a serious impact on the respiratory system function of children [1]. Although the symptoms of wheezing can be delayed by drug treatment, there is still a risk of recurrence [2]. Therefore, it is of great clinical significance to find a simple and reliable biological indicator to predict the prognosis of children with asthma.

Relevant studies have shown that inflammatory response is closely related to the occurrence and persistence of airway hyperreactivity in children [3]. Systemic immunoinflammatory index and Systemic inflammatory response index (SIRI) are two new clinical inflammatory markers [4]. They are relatively simple to obtain, provide important information for diseases related to inflammation response, and currently have significant advantages as markers of disease diagnosis and prognosis. Additionally, they can better reflect the severity of the disease [5]. $CD4^+$ represents T helper cells to activate and regulate immune function, and $CD8^+$ represents T suppressor cells to inhibit immune function [6]. Studies have shown that the imbalance of $CD4^+/CD8^+$ ratio is an important link in the occurrence of bronchial asthma [7]. This study aims to investigate the association between these three indicators and bronchial asthma, and the results are reported as follows.

2. Materials and methods

2.1 Patient and general information

A total of 98 children with bronchial asthma admitted to our hospital from January 2020 to February 2024 were retrospectively collected. All the children were in the acute stage of bronchial asthma. The diagnosis of bronchial asthma was consistent with the 2022 edition of the Global Initiative for Asthma Prevention GINA) [8].

Exclusion criteria: (1) Patients with combined immunodeficiency disease; (2) Combined with other systemic diseases; (3) Patients with serious heart, brain, kidney and other organic diseases; (4) Patients are generally in poor condition.

Another 50 healthy children who underwent physical examination in our hospital during the same period were selected as

the control group.

All children's clinical data were complete, and all children's families gave informed consent to the study and signed consent forms. The study was approved by the hospital Ethics Committee.

2.2 Research method

General data of all subjects were collected, including sex, age, Body Mass Index (BMI), laboratory indicators (C-reactive protein (CRP), Eosinophils (EOS)). Children with bronchial asthma also included whether they had nebulized inhalation, whether they had long-term use of glucocorticoids, whether they had combined invasive procedures, the number of asthma attacks and history of allergies.

Collect early morning fasting peripheral elbow venous blood 3 to 4 mL. Routine blood values were measured in a blood cell analyzer, and SII and SIRI were calculated. SII = platelet count × neutrophil count/lymphocyte count. SIRI = neutrophil count × monocyte count/lymphocyte count. $CD4^+$ and $CD8^+$ were detected by flow cytometry, and $CD4^+/CD8^+$ values were calculated.

Symptomatic treatment was given to all patients. After 28 days of treatment, pulmonary function examination was performed on all patients to get peak expiratory flow (PEF) and forced expiratory volume in one second (FEV1).

All children with bronchial asthma performed childhood asthma control test (C-ACT), in which five dimensions were included: symptoms, chest tightness and dyspnea, exercise ability, night symptoms and frequency of emergency medication [9]. Total points are 25. 25 points refer to completely controlled, 20 to 14 is well controlled, and <20 is not controlled.

All the children were treated with aerosol inhalation of glucocorticoids after admission. After 28 days of treatment, the patients were divided into well-controlled group and poor-controlled group according to the improvement of pulmonary function indexes and C-ACT results. Well-controlled group means the C-ACT score was ≥20, and the pulmonary function index returned to normal.

2.3 Statistical methods

The statistical software was SPSS 25.0 (IBM, Armonk, NY, USA), and the measurement data conforming to normal distribution were statistically described by means of ± standard deviation ($\bar{x} \pm s$), and comparison between the two groups was performed by *t*-test. Measurement data that did not conform to normal distribution were described by "median (quartile) (M (Q1, Q3))", non-parametric test was adopted, and comparison between the two groups was performed by Mann-Whitney U rank sum test.

3. Results

3.1 Clinical data of children with bronchial asthma and healthy control group

The study included 98 children with bronchial asthma (disease group) and 50 healthy volunteers (control group), and the clinical data were shown in Table 1.

Among all the 98 patients, 65 patients were well prognosis and 33 patients were poor prognosis. The clinical data are shown in Table 2.

3.2 Comparison of SII, SIRI and $CD4^+/CD8^+$ indexes between children with bronchial asthma and healthy controls

As shown in Table 3, SII and SIRI in the disease group were significantly higher than those in the control group ($p < 0.05$), and $CD4^+/CD8^+$ was significantly lower than that in the control group ($p < 0.05$).

3.3 Comparison of SII, SIRI and $CD4^+/CD8^+$ indexes in children with different prognosis

As shown in Table 4, SII and SIRI in the poor prognosis group were significantly higher than those in the good prognosis group ($p < 0.05$), and $CD4^+/CD8^+$ was significantly lower than those in the good prognosis group ($p < 0.05$).

4. Discussion

Asthma is a chronic airway inflammatory disease caused by T lymphs, eosinophils (EOS), neutrophils, mast cells and other cellular and multicellular components under the joint action of environmental and genetic factors [10]. It is often accompanied by airway hyperresponsive and reversible airflow limitation. Lead to repeated episodes of wheezing, shortness of breath, chest tightness, cough and other symptoms, generally aggravated in the morning or at night [11]. With repeated ill-

TABLE 1. Clinical data of children with bronchial asthma and healthy volunteers.

Project	Disease group (n = 98)	Control group (n = 50)	Statistic	*p*
Sex				
Female	41 (41.84%)	27 (54.00%)	$\chi^2 = 1.972$	0.160
Male	57 (58.16%)	23 (46.00%)		
Age	5.50 ± 1.45	5.52 ± 1.40	$t = 0.080$	0.936
BMI (kg/m^2)	19.78 ± 1.81	19.83 ± 1.92	$t = 0.133$	0.894
CRP (mg/L)	4.87 ± 1.09	4.79 ± 1.00	$t = 0.425$	0.672
EOS (10^9/L)	0.318 ± 0.048	0.320 ± 0.092	$t = 0.182$	0.856

BMI: Body Mass Index; CRP: C-reactive protein; EOS: Eosinophils.

TABLE 2. Clinical data of children with bronchial asthma with good prognosis and poor prognosis.

Project	Well prognosis group (n = 65)	Poor prognosis group (n = 33)	Statistic	*p*
Sex				
Female	29 (44.62%)	12 (36.36%)	$\chi^2 = 0.612$	0.434
Male	36 (55.38%)	21 (63.64%)		
Age	5.49 ± 1.39	5.52 ± 1.58	$t = 0.073$	0.942
BMI (kg/m^2)	19.72 ± 1.84	19.90 ± 1.76	$t = 0.454$	0.651
Atomized inhalation	19 (29.23%)	11 (33.33%)	$\chi^2 = 0.173$	0.677
Long-term use of glucocorticoids	14 (21.54%)	9 (27.27%)	$\chi^2 = 0.401$	0.527
Number of asthma attacks	2.95 ± 1.18	2.91 ± 0.98	$t = 0.188$	0.852
Allergic history	8 (12.31%)	5 (15.15%)	$\chi^2 = 0.154$	0.695
CRP (mg/L)	4.90 ± 1.05	4.82 ± 1.19	$t = 0.312$	0.756
EOS (10^9/L)	0.318 ± 0.041	0.317 ± 0.060	$t = 0.165$	0.869

BMI: Body Mass Index; CRP: C-reactive protein; EOS: Eosinophils.

TABLE 3. Comparison of SII, SIRI and CD4$^+$/CD8$^+$ in children with bronchial asthma and healthy control group.

Project	n	SII	SIRI	CD4$^+$/CD8$^+$
Disease group	98	501.89 ± 72.49	1.60 ± 0.41	1.15 ± 0.23
Control group	50	385.61 ± 66.52	1.35 ± 0.77	1.28 ± 0.25
Statistic		$t = 9.754$	$t = 2.102$	$t = 3.126$
p		<0.001	0.012	0.002

SII: Systemic immunoinflammatory index; SIRI: Systemic inflammatory response index; CD: Cluster of Differentiation.

TABLE 4. Comparison of SII, SIRI and CD4$^+$/CD8$^+$ indexes in children with bronchial asthma with good prognosis and poor prognosis group.

Project	n	SII	SIRI	CD4$^+$/CD8$^+$
Well prognosis group	65	468.44 ± 58.90	1.48 ± 0.38	1.22 ± 0.21
Poor prognosis group	33	567.77 ± 47.34	1.82 ± 0.38	1.01 ± 0.21
Statistic		$t = -9.019$	$t = -4.182$	$t = 4.456$
p		<0.001	<0.001	<0.001

SII: Systemic immunoinflammatory index; SIRI: Systemic inflammatory response index; CD: Cluster of Differentiation.

ness, it can induce physiological characteristics such as airway hyperresponsiveness and increased airway mucus secretion, aggravate respiratory dysfunction, and even cause irreversible damage to the respiratory system, seriously affecting the health of children [12].

The Systemic Immunoinflammatory Index (SII) is a novel biomarker for malignancies and inflammatory diseases that brings together counts of three inflammatory peripheral cells, including neutrophils, lymphocytes and platelets [13]. The Systemic Inflammatory Response Index (SIRI), a collection of neutrophil, lymphocyte and monocyte counts that indicate a balance between inflammatory response and immune status, is calculated from simple laboratory parameters and can be considered a cost-effective indicator for practical applications [14]. In our study, the expression levels of SII and SIRI were significantly increased in children with bronchial asthma, and their expression was also significantly increased in children with poor prognosis, highlighting the role of neutrophils, platelets and lymphocytes in the pathogenesis of asthma, which are closely associated with increased risk of asthma.

The imbalance of CD4$^+$/CD8$^+$ ratio is considered to be an important link in the occurrence and development of bronchial asthma [15]. Our study found that the CD4$^+$/CD8$^+$ ratio was significantly reduced in children with asthma, and in children with poor prognosis, the CD4$^+$/CD8$^+$ ratio was also significantly decreased. CD4$^+$ T cell is a kind of effector T cell produced by differentiation of initial T cells in peripheral lymphoid tissue after being attacked by antigens [16]. It is mainly involved in cellular immunity and plays a chemotactic and activation role in other lymphocyte functions and inflammatory cells. CD8$^+$ T cell refers to cytotoxic T lymphocytes, representing T suppressor cells to suppress immune function [17], and the decrease of CD4$^+$/CD8$^+$ ratio reflects the impaired immune function of the body, which is

closely related to the onset and progression of asthma [18].

There are also many shortcomings in this study, mainly as follows: (1) This study is a single-center retrospective study, the number of included samples is limited, and the three indicators in the study are affected by many factors such as emotions and eating habits, so the results are inevitably biased, and a large-scale multi-center clinical study is required if necessary.

5. Conclusions

SII, SIRI and $CD4^+/CD8^+$ are closely related to children with acute attack of bronchial asthma. Both SII and SIRI prove to be effective in predicting disease progression. These indicators deserve further attention in clinical practice.

AVAILABILITY OF DATA AND MATERIALS

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

FQX—designed the study and carried them out; supervised the data collection. FQX, QZ, FZC—analyzed the data; prepared the manuscript for publication and reviewed the draft of the manuscript. FQX, QZ—interpreted the data. All authors have read and approved the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Ethics Committee of Anhui Provincial Children's Hospital (Approval no. EYLL-2022-010). Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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