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ORIGINAL

EXPLORING IL-6 AS A MARKER OF RESPIRATORY HEALTH IN ATHLETES: INSIGHTS FROM PSITTACOSIS PNEUMONIA RESEARCH

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ABSTRACT

Objective: This study aims to explore the correlation between interleukin-6 (IL-6) levels and the condition of patients with psittacosis pneumonia, and extend these insights to the context of respiratory health in athletes. **Methods:** In a retrospective analysis, we included 14 patients diagnosed with psittacosis pneumonia (parrot fever) treated in our hospital from April 2018 to September 2021 as the study group (SG). As a control group (CG), we selected 20 patients with common pneumonia treated during the same period. We compared IL-6 levels between these groups and recorded changes in IL-6 levels in the SG before and after treatment. Additionally, we analyzed the correlation of IL-6 levels with procalcitonin (PCT) and C-reactive protein (CRP) levels. **Results:** The IL-2 levels in the SG were significantly lower than those in the CG, while IL-6 levels were significantly higher. No significant difference was observed in IL-10 and IL-6 levels between the groups ($P>0.05$). The average IL-6 level in the SG was 80.78±46.20 ng/L before treatment and 7.86±6.73 ng/L after treatment, showing a significant reduction ($P<0.05$). There was a significant positive correlation between IL-6 levels and PCT levels in the SG ($r=0.2659$, $P<0.05$), but the correlation with CRP levels was not significant ($r=0.0033$, $P=0.8465$). The Area Under Curve (AUC) of IL-6 for diagnosing psittacosis pneumonia was 0.7929 ($P=0.0041$). **Conclusion:** Patients with psittacosis pneumonia exhibit distinct interleukin level changes, particularly in IL-2 and IL-6, compared to those with ordinary pneumonia. The correlation of IL-6 with PCT levels suggests its potential as a marker in assessing respiratory health conditions, which could be relevant for monitoring respiratory health in athletes,

given the heightened susceptibility to respiratory issues in this group.

KEYWORDS: Interleukin-6 levels; Parrot fever pneumonia; Disease-related; Calcitoninogen; C-reactive protein; Respiratory Health in Athletes; Immune Response in Athletes

1. INTRODUCTION

The pursuit of peak athletic performance often places athletes in unique physiological and environmental circumstances that can impact their respiratory health. In recent years, researchers and sports medicine practitioners have recognized the significance of investigating novel biomarkers to monitor and assess respiratory health in athletes. One such biomarker that has garnered attention is Interleukin-6 (IL-6) (Cho et al., 2021; Shi et al., 2021). IL-6 is a cytokine with multifaceted roles in the human body, including its involvement in the immune response and inflammation regulation. Beyond its traditional functions, IL-6 has emerged as a potential marker of respiratory health, particularly in the context of athletes who are exposed to diverse challenges such as intense physical exertion, environmental factors, and potential respiratory infections. This study delves into the exploration of IL-6 as a marker of respiratory health in athletes, drawing insights from research on Psittacosis pneumonia. Psittacosis pneumonia is a respiratory infection caused by the Chlamydia psittaci bacterium, which can affect both humans and birds. Studying the role of IL-6 in the context of this infection provides a unique opportunity to understand its potential relevance to athletes' respiratory well-being. (Raderer, Kiesewetter, & Ferreri, 2016), (Alleluyanatha & Treasure, 2021).The objective of this research is to investigate IL-6 levels in athletes and assess their correlation with respiratory health parameters. By examining IL-6 as a potential biomarker in the athlete population(Balsamo et al., 2017) , we aim to contribute to a deeper understanding of how this cytokine may reflect the complex interplay between physical activity, immune responses, and respiratory health. (Chen et al., 2020; Gu et al., 2020; Zhou, 2022). The intersection of sports science and medical research continues to provide valuable insights into optimizing the health and performance of athletes. This study underscores the importance of exploring innovative biomarkers like IL-6 to advance our knowledge of respiratory health in athletes, potentially leading to better monitoring, prevention, and management strategies in the pursuit of excellence in sports.(Hogerwerf, De Gier, Baan, & Van Der Hoek, 2017; Kong, Zhu, Lu, & Xu, 2021).

2 MATERIALS AND METHODS

2.1 General data

Retrospectively, 14 patients with parrot fever pneumonia who were healed in our hospital from April 2018 to September 2021 were opted as the

study cluster (SG), and 20 patients with common pneumonia who received healing in our hospital during the same period were opted as the control cluster (CG). This study has been approved by the hospital ethics committee.

Inclusion criteria: (1) All patients in the research cluster were diagnosed with psittacosis pneumonia and had corresponding clinical symptoms; (2) The clinical data were complete and complete. Exclusion criteria: (1) Those with incomplete case data; (2) Those aged ≤ 18 years; (3) Those who have been included in other unresolved clinical investigators; (4) Those with a history of drug or alcohol abuse.

2.2 Intervention methods

The general clinical data of the two clusters of patients were extracted, including gender, age, disease course, white blood cell count, neutrophil count, etc. Data; data of PCT and CRP levels before healing in the study cluster were extracted.

2.3 Observation indicators and evaluation standards

The variations in general clinical data of the two clusters of patients were contrastd; the variations in the levels of IL-2, IL-4, IL-6 and IL-10 at admission were contrastd between the two clusters; the variations in the levels of IL-6 in the study cluster before and after healing were contrastd; Pearson Correlation analysis of the relationship between IL-6 levels and their CRP and PCT levels in the study cluster.

2.4 Methods

T-test was used for the contrastion of measurement data that obeyed normal distribution and homogeneity of variance, and was described by (mean ± standard deviation), and non-parametric data was used for skewed data or measurement data with unequal variance. The Mann-Whitney test (U test) in the test was described by the median (upper and bottom quartiles), and the measurement data was contrastd by the chi-square test, which was expressed as cases (%). The correlation between PCT and PCT levels was analyzed by Pearson, and the diagnostic value of IL-6 in psittacosis pneumonia was analyzed by drawing ROC curve. $P<0.05$ was considered notable.

3. RESULTS

3.1 Contrastion of general clinical data of two clusters of patients

The gender, age, course of disease, white blood cell count, neutrophil count and other general data of the two clusters of patients were included, and the variations between the two clusters were contrastd. The results showed that none notable variation between the two clusters in the above data part ($P> 0.05$),

indicating good comparability. Table 1 and Figure 1.

Table 1. Contrastion of general data of the two clusters of patients ($\overline{x} \pm s$)/[n (%)]

GENERAL CLINICAL INFORMATION		RESEARCH CLUSTER（N=14）	CONTROL CLUSTER（N=20）	T/χ^2	*P*
Gender	Male	6	12	0.971	0.324
	Female	8	8		
Mean age (years)		68.43±14.59	60.75±14.86	1.911	0.065
Mean duration of illness (d)		4.29±2.13	3.90±3.04	0.413	0.682
White blood cell count (×109/L)		8.40±2.98	11.60±3.94	2.564	0.055
Neutrophil count (×109/L)		0.83±0.10	0.80±0.10	0.861	0.395
Lymphocyte count		0.12±0.09	0.09±0.05	1.246	0.222

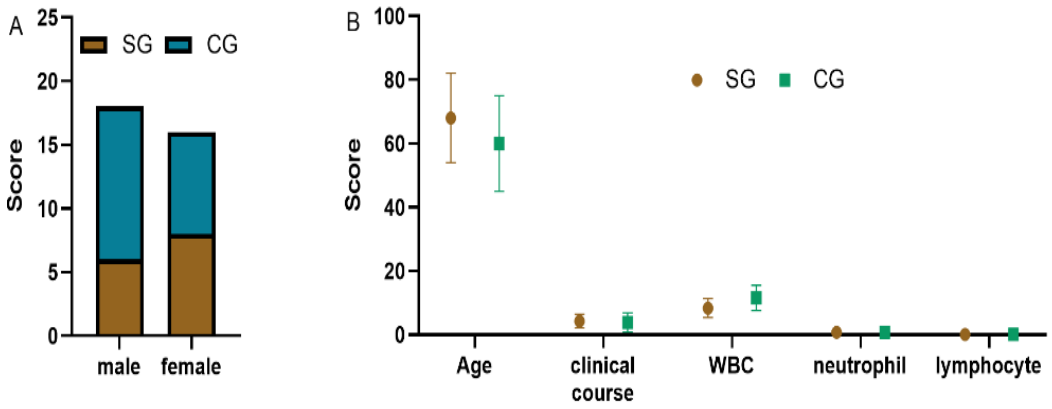

Figure 1. Contrastion of general data of the two clusters of patients None notable variation in gender, age, course of disease and other data between the two clusters (P>0.05).

3.2 Contrastion of interleukin levels in the two clusters of patients

The contrastion showed that the level of IL-2 in the study cluster was notably bottom than that in the control cluster, while the level of IL-6 was notably upper than that in the control cluster. None notable variation in the levels of IL-10 and IL-10 between the two clusters (P>0.05). Table 2 and Figure 2.

Table 2. Contrastion of interleukin levels in the two clusters of patients ($\overline{x} \pm s$ ， ng/L)

CLUSTER	CASES	IL-2	IL-4	IL-6	IL-10
Study cluster	14	0.08±0.05	0.10±0.10	80.78±46.20	0.61±0.72
Control cluster	20	0.24±0.23	0.29±0.50	2.34±1.66	5.07±20.33
t	-	2.550	1.396	7.637	0.817
P	-	0.016	0.172	<0.001	0.420

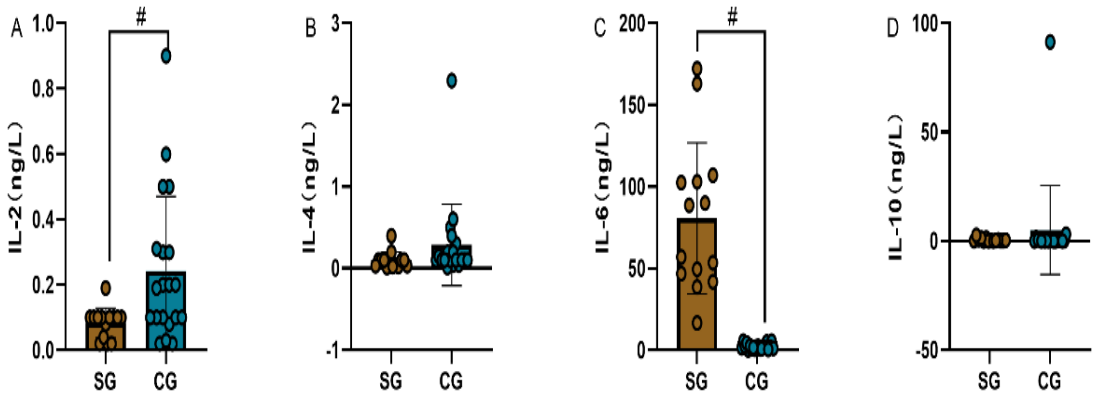

Figure 2. Contrastion of interleukin levels in the two clusters The levels of IL-2 (Figure A) in the study cluster were notably bottom than those in the control cluster, while the level of IL-6 (Figure C) was notably upper than that in the control cluster, and the above two indicators were notably variate between the clusters. There was variation (P<0.05), and none notable variation between the two clusters in the levels of IL-4 (Figure B) and IL-10 (Figure D) (P>0.05). # indicates that the variation between the same index clusters is notable.

3.3 Changes of IL-6 levels in the study cluster before and after healing

The calculation showed that the average level of IL-6 in the study cluster was (80.78±46.20) ng/L before healing and (7.86±6.73) ng/L after healing, and the variation was notable (P<0.05). Table 3 and Figure 3.

Table 3. Changes of IL-6 levels in the study cluster before and after healing ($\overline{x} \pm s$ ， ng/L)

CLUSTER	CASES	IL-6
Before healing	14	80.78±46.20
After healing	14	7.86±6.73
t	-	5.844
P	-	<0.001

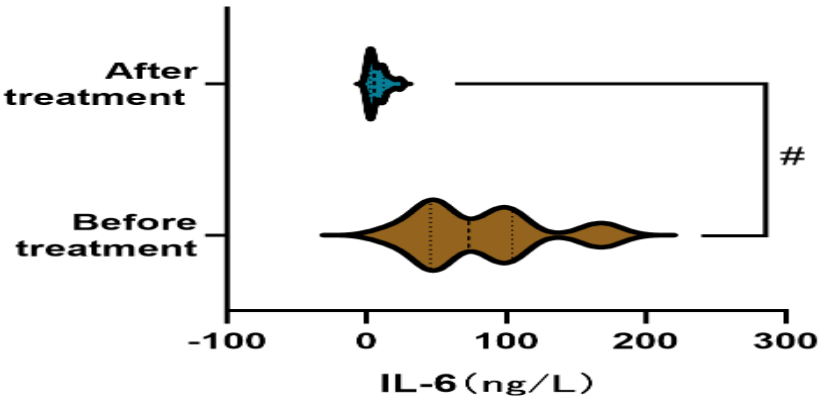

Figure 3. Analysis of the changes of IL-6 levels in the study cluster before and after healing The average level of IL-6 in the study cluster before healing was (80.78±46.20) ng/L, and after healing was (7.86±6.73) ng/L, there is a variation between before and after healing Academic variation (P<0.05). # indicates that the variation between the same index clusters is notable.

3.4 Correlation analysis of IL-6 level with PCT and CRP in the study cluster

The Pearson correlation analysis was carried out between the IL-6 level and the PCT level of the patients in the study cluster. The results showed that the IL-6 level of the patients in the study cluster was positively correlated with the PCT level (r=0.2659, P<0.05), and it was notably correlated with the CRP level. The correlation was not notable (r=0.0033, P=0.8465). Figure 4.

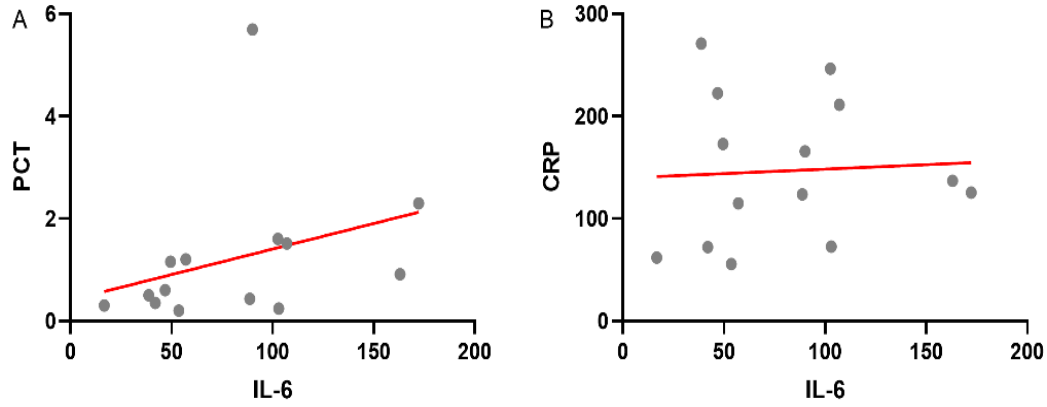

Figure 4. Correlation analysis between IL-6 level and PCT and CRP in the study cluster The IL-6 level in the study cluster was positively correlated with the PCT level (r=0.2659, P<0.05) (Fig. A), and it was notably correlated with the CRP level. The correlation was not notable (r=0.0033, P=0.8465) (Panel B).

2.5 Analysis of the diagnostic value of IL-6 in psittacosis pneumonia

By drawing the ROC curve, it was calculated that the AUC of IL-6 for the diagnosis of psittacosis pneumonia was 0.7929 (P=0.0041). Figure 5.

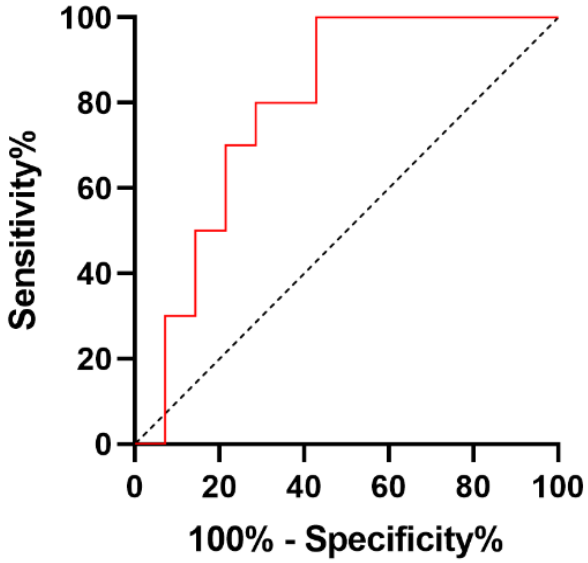

Figure 5. Analysis of the diagnostic value of IL-6 for psittacosis pneumonia The AUC of IL-6 for the diagnosis of psittacosis pneumonia was 0.7929 (P=0.0041).

4. DISCUSSION

Psitetti fever was first reported by scholars Ritter et al. It was an epidemic pneumonia caused by close contact with pet birds, and then human psittacosis outbreaks occurred successively in Europe and America in the 1920s and 1930s (Opota, Brouillet, Greub, & Jaton, 2017). With the in-depth research on chlamydia, Chlamydia psittaci cannot only cause respiratory tract infections in birds, but also infect humans through close contact, and other mammals such as cattle, horses, and pigs can also be infected (Su et al., 2021). Due to the severity of the disease and the ineffectiveness of antibiotic-based healings and immunotherapies, psittacosis has a severe impact on human society.

Psittacosis pneumonia is a typical clinical manifestation of psittacosis. Patients may have symptoms such as high fever, headache, and cough, and severe cases may develop into myocarditis, hepatitis, and neurological complications. Early variateial diagnosis is of great variation to improve the prognosis of patients with psittacosis. (Lugert et al., 2017; Zucca & Bertoni, 2016). However, on the one hand, the culture requirements of chlamydia are high, and it is difficult to carry out in general laboratories. On the other hand, polymerase chain reaction has high diagnostic sensitivity only in the acute phase of patients. Therefore, most hospitals have shortcomings in the variateial diagnosis of parrot fever pneumonia (Anstey et al., 2021) . In this study, by setting up a control cluster, using the more common interleukin indicators in serological examinations as the starting point, the correlation between IL-6 levels and the condition of patients with psittacosis pneumonia was analyzed. The results showed that, contrastd with normal pneumonia patients, the serum IL-2 level in psittacosis pneumonia patients was notably bottom, while the IL-6 level was notably upper. A study on children with Mycoplasma pneumoniae infection found that 25 children with Mycoplasma pneumoniae had notably bottom serum IL-2 levels in acute phase than normal children, while IL-6 levels were notably upper than normal children. In the acute stage of mycoplasma pneumonia, the level of IL-2 in children was notably correlated with the level of IL-6 ($r=-0.871$, $P<0.001$) (Wannaratana, Thontiravong, Amonsin, & Pakpinyo, 2017). Another study on 24 patients with Chlamydia psittacosis pneumonia pointed out that the level of IL-6 in patients with Chlamydia psittacosis pneumonia was notably upper than that in patients with Mycoplasma pneumoniae pneumonia (181.60pg/ml vs 15.60pg/ml), the variation was notable (Liu et al., 2021), These are similar to the results of this study.

The author of this paper analyzes that the inflammatory response is the central link in the pathogenesis of chlamydia, and the repeated and persistent inflammatory response is the main cause of chronic pathological damage to the body's tissues and organs. As mentioned above, Chlamydia psittacosis induces host cells to secrete cytokines represented by interleukins by infecting macrophages. The immunopathological process in turn leads to inflammatory

damage (Pang et al., 2021), so inflammatory factors can be used clinically as indicators to assess the degree of patient condition or tissue damage. As an important endogenous pyrogen, IL-6 is the final state factor of B cells, which can induce the physiological activities of B cells and improve the ability of NK cells to kill target cells (Wu, Feng, & Fang, 2021). The results in this paper confirm the inflammation in patients with psittacosis pneumonia. The notion that the response intensity is greater than that of ordinary pneumonia also confirms that IL-6 changes with the condition of psittacosis pneumonia.

In order to further analyze the diagnostic value of IL-6 in psittacosis pneumonia, the correlation between IL-6 level and PCT and CRP was analyzed in this paper. $P<0.05$), many studies have shown that PCT levels are abnormally expressed in patients with psittacosis pneumonia, and PCT levels in patients with good prognosis will be notably reduced (Wen et al., 2021), but some studies have pointed out that PCT levels are easily affected by the pathological state of the body, Its diagnostic specificity for psittacosis pneumonia is low (Wang, Lu, Shao, & Wang, 2020). The authors of this paper believe that the results in this paper further confirm the correlation between the level of IL-6 and the disease of psittacosis, and it is related to the commonly used serological index PCT. Finally, by drawing the ROC curve, it can be found that IL-6 has a high diagnostic efficiency. It provides data support for its clinical application(Zaccara, Ries, & Jaffrey, 2019).

5. CONCLUSION

In conclusion, the exploration of Interleukin-6 (IL-6) as a potential marker of respiratory health in athletes, drawing insights from research on Psittacosis pneumonia, provides valuable perspectives on the intricate relationship between physical activity, immune responses, and respiratory well-being in the athletic population. The study suggests that IL-6 may indeed serve as a noteworthy biomarker for assessing respiratory health in athletes. Elevated IL-6 levels, as observed in response to respiratory infections such as Psittacosis pneumonia, could be indicative of compromised respiratory function in this physically active group. Monitoring IL-6 levels may offer a means of early detection and intervention for respiratory issues among athletes, ultimately contributing to improved health and performance outcomes. Furthermore, this research underscores the interdisciplinary nature of sports science and medicine, emphasizing the importance of drawing insights from diverse fields to enhance our understanding of athlete health. The potential utility of IL-6 as a respiratory health marker highlights the need for continued exploration of novel biomarkers and their application in the context of sports and fitness.

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