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Research Article

The Dynamic Changes of White Blood Cell Count and Lymphocyte Count and Compare their Levels in the Early Stage of COVID-19

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Abstract

COVID-19 is a new infectious disease, which needs to explore the clinical value of white blood cell count and lymphocyte to provide help for diagnosis and treatment. COVID-19 cases were Selected that admitted to 2 hospitals in Guizhou, China. WBC and LYM in the 1st day, in the 4th day and in the 7th day after onset were collected. There were not any differences in The WBC and LYM in the 4th day and the 7th day between the two groups. WBC and LYM in the 1st day in the moderate group were lesser than in the mild group. WBC and LYM were no dynamic changes in the mild group. In moderate group, WBC and LYM in the 1st day were lesser than in the 4th day. The levels in the 4th day and the 7th day were no differences. The conclusion was In the early stage of COVID-19, the WBC and LYM in moderate patients were significantly decreased within 4 days after onset, and could be restored to normal level after 4-7 days. However, no dynamic changes were observed in mild patients within 7 days.

Keywords:
COVID-19; white blood cell; lymphocyte

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Introduction

New coronavirus pneumonia(COVID-19) is a new infectious disease with strong infectivity [1]. It is in the midst of a global pandemic. The pathologic and physiological processes of COVID-19 are unclear, and the current diagnosis and treatment methods are still defective. So a comprehensive study of COVID-19 is urgently needed. White blood cell count (WBC) and lymphocyte count (LYM) have important role in differential diagnosis of infectious diseases. Studies have reported that blood routine examination results showed that WBC and LYM have been reduced in more patients with COVID-19[2, 3]. The rate was higher in patients with intensive and critically ill. Testing for WBC and LYM may have important clinical implications for timely diagnosis and assessment of disease severity in patients with COVID-19[4-6]. In this study, we observed the dynamic changes of WBC and LYM in the early stage of mild COVID-19 and moderate COVID-19, so as to provide help for clinical diagnosis and treatment.

Material and Methods

Subjects

Confirmed COVID-19 cases admitted to 2 hospitals of Guizhou from January 23, 2020 to March 20, 2020 were selected, 8 cases were from the People's Hospital of Qiandongnan Miao and Dong Autonomous Prefecture, 36 cases were from the Jiangjunshan Hospital of Guiyang. 44 cases were selected in the study. Included 23 males and 21 females, aged from 5 months to 51 years with a mean age of 31.40 ±12.91 years. 22 cases were mild COVID-19, and 22 cases were moderate COVID-19.

Criteria for grouping

In line with the Chinese COVID-19 diagnostic and therapeutic regimen(trial 8th edition) [4], The confirmed patients tested positive for viral nucleic acid. *Mild group*: The clinical symptoms were mild, and no signs of pneumonia were found on imaging. Moderate group: Patients had fever or respiratory symptoms, and imaging showed signs of pneumonia.

Severe groups

Comply with any of the following: 1. The shortness of breath, adult respiratory frequency (RR)≥30 times/min, (If children were younger than 2 months, RR≥60 times/min;2 ~ 12 months old,RR≥ 50 times/min; 1 ~ 5 years old, RR≥40 times/min; >5 years old, RR≥30 times/min, excluding the effects of fever and crying). 2. At rest, oxygen saturation ≤93% when inhaling air. 3. Arterial partial pressure of oxygen (PaO2)/oxygen absorption concentration (FiO2) ≤300 mmHg (1 mmHg=0.133 kPa). 4. The clinical symptoms were progressively aggravated, and pulmonary imaging showed a significant increase of >50% within 24 ~ 48 hours.

Critical group

Mechanical ventilation was required or shock occurs [4].

Early definition of COVID-19

Within 7 days after the onset of clinical symptoms (fever or cough). If the patients weren't clinical symptoms, it was 7 days after tested positive for nucleic acid.

Inclusion criteria and Exclusion criteria

1. Inclusion criteria

The criterion for confirming COVID-19 was a positive viral nucleic acid test. 2. Exclusion criteria: Because only a few critical and severe cases have been collected, so critical COVID-19 and severe COVID-19 were excluded. Patients with bacterial infections, malignancy, cirrhosis, uremia, hematological diseases, immune deficiency, hypersplenism, exposure to radioactive substances and other diseases that can reduce the WBC were excluded, and patients with incomplete data were excluded. Patients who conformed the mild COVID-19 and moderate COVID-19 diagnostic criteria were included. The cases were divided into mild group and moderate group.

Methods

This study was approved by the ethics committee of the people's hospital of Qiandongnan Miao and Dong Autonomous Prefecture. We performed a retrospective study. The cases were divided into mild group and moderate group. WBC and LYM in the 1st day, the 4th day, and the 7th day after onset were collected. The differences in these indicators were compared at different time within the group. The differences in these indicators at the same time point was compared between the two groups.

Statistical analysis

The statistical analysis was performed using the SPSS 24.0 software. Measurement data with normal distribution are expressed as mean ± standard deviation (mean ±SD), and comparisons among the groups were performed using the one-way analysis of variance (ANOVA) followed by LSD test (homogeneity of variance was determined) or Tamhane's T2 test, *u* was used to indicate. Numeration data was analyzed by chi-square test. The significance level was set at $p<0.05$.

Results

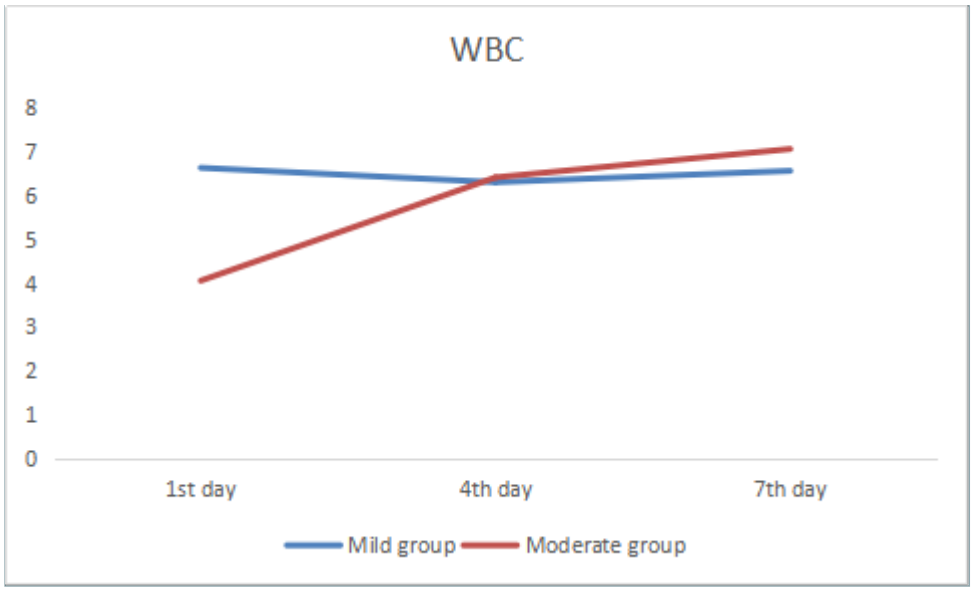

Figure 1. Dynamic changes of WBC in different group

As shown in Table 1, Table 2, Figure 1 and Figure 2, There were no differences in The WBC and LYM in the 4th day and the 7th day between the two groups (*t/U*=-0.064, -0.747, -0.278, -0.416 *P*>0.05). WBC and LYM in the 1st day in moderate group was lesser than in mild group (*U*=-3.135, -2.013 *P*<0.05). WBC and LYM in the 1st day, the 4th day and the 7th day were no change in the mild group (*t*=0.755,

Table 1. Comparison of WBC and lym between mild and moderate groups in early stage of COVID-19

Parameter	Mild group(n=22)	Moderate group(n=22)	$\chi^2/t/u$ value	*p* value
Gender (male/Female)	9/13	14/8	2.226	0.227
Age (years)	31.32±11.31	32.48±14.60	-0.040	0.968
WBC in the 1st day(10^9/L)	6.64±1.62	4.06±0.30	-3.135	0.001
WBC in the 4th day(10^9/L)	6.31±1.30	6.42±2.47	-0.064	0.962
WBC in the 7th day(10^9/L)	6.57±1.39	7.07±2.38	-0.747	0.461
LYM in the 1st day(10^9/L)	1.81±0.51	1.38±0.24	-2.013	0.046
LYM in the 4th day(10^9/L)	1.96±0.44	2.44±1.59	-0.278	0.797
LYM in the 7th day(10^9/L)	1.83±0.54	2.19±1.29	-0.416	0.694

Table 2. Dynamic changes of WBC and LYM in early stage of COVID-19

Parameter	*t* value or *p* value	Mild group(n=22)	Moderate group(n=22)
WBC in the 1st day vs WBC in the 4th day	*t* value	0.755	-2.390
	p value	0.464	0.027
WBC in the 4th day vs WBC in the 7th day	*t* value	-1.452	1.052
	p value	0.165	0.316
LYM in the 1st day vs LYM in the 4th day	*t* value	0.268	-5.171
	p value	0.793	0.001
LYM in the 4th day vs LYM in the 7th day	*t* value	1.577	1.609
	t value	0.755	-2.390

-1.452, 0.268, 1.577 $P>0.05$). In moderate group, WBC and LYM in the 1st day was lesser than in the 4th day (t=-2.390, -5.171 $P<0.05$), the levels in the 4th day and the 7th day was no differences (t=1.052, 1.609 $P>0.05$).

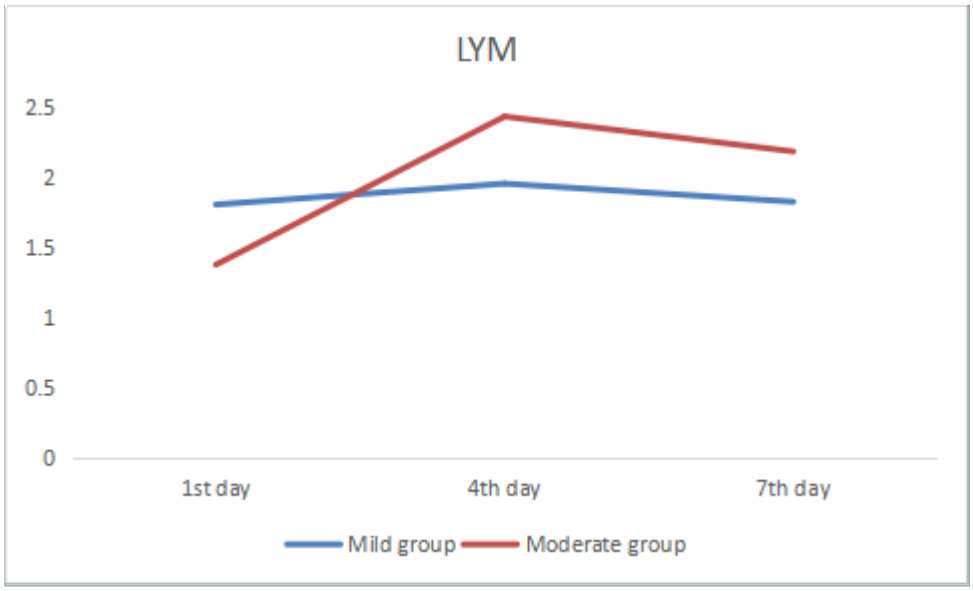

Figure 2. Dynamic changes of LYM in different group

Discussion

The global outbreak of COVID 19 has overwhelmed global health systems and posed severe challenges to human health and safety [7]. As a new infectious disease, COVID-19 needs to continue to summarize the experience in prevention and treatment measures. Clinical monitoring index plays an important role in the diagnosis and evaluation of the disease. WBC and LYM are commonly used indicators for infection monitoring. Many studies have suggested that WBC and LYM can help diagnose and assess COVID-19[8-10]. But the dynamic changes of WBC and LYM are unknown in patients with different degrees of severity. This study explored the dynamic changes of WBC and LYM in patients with different degrees of severity and analyzed their clinical significance.

WBC is comprised of lymphocyte, basophil, neutrophils, eosinophils and monocytes. The main function of WBC is defense. Different types of WBC participate in the body's defense response in different ways. Normal or reduced WBC in patients with viral infection is part of the important characteristics [11]. WBC can assist in the diagnosis of COVID-19. Other studies have shown a certain correlation between WBC and prognosis [12, 13]. In this study, there was no dynamic change in WBC level in patients with mild COVID-19 at the early stage. The WBC level in the 1st day of moderate COVID-19 was lesser than that in the 4th day and the 7th day, shown that moderate COVID-19 produced a strong prophylactic response in the body at a very early stage. The WBC rebound may be an indication that the disease is under control if there is no bacterial infection, or that the body's need for a preventive response has weakened. The level of WBC in the 1st day in patients with moderate COVID-19 was lesser than that in patients with mild COVID-19, shown that the chemotaxis of WBC in patients with moderate COVID-19 was stronger than that in patients with mild covid-19 in the super early stage. It shows if severity of the disease in the early stage was more. The severe the body's defense response was strong.

One study suggest that both innate and adaptive immune responses are essential for controlling COVID-19 infection [14]. LYM is a class of immune cells, mainly involved in the body's specific immune response. Novel coronavirus can be used as an antigen to stimulate the body to produce a specific immune response, followed by immune damage. Some researchers have reported peripheral blood lymphocyte count reduction in patients with severe COVID-19[15]. The same findings were found at autopsy in patients who died. The number of lymphocytes in the spleen and hilum of the lung significantly decreased, and both CD4+T cells and CD8+T cells in lymph nodes decreased [16]. The cases in this study were COVID-19 mild and moderate cases. No significant change of LYM was observed in the mild group at the early stage, indicating that the immune damage of the mild patients was relatively light. The LYM in the 1st day was lesser than the 4th day, shown that a strong and specific immune response may occur in the early stage. The LYM in the 1st day in the moderate group was lesser than that in the mild group, shown that in the super early stage (less than 4 days). The specific immunity produced in the moderate group was stronger than that in the mild group. It is speculated that sustained and severe immune injury may be essential for the occurrence of severe cases.

WBC and LYM exist important clinical significance in patients with mild COVID-19 and moderate COVID-19. The value of WBC and LYM in severe COVID-19 and critical COVID-19 requires further study. For critically ill patients more than 7 days later, WBC and LYM may have profound changes. At the same time, WBC and LYM lack specificity and sensitivity. When using these indicators, comprehensive analysis is needed to improve the guiding value of clinical diagnosis and treatment. The disadvantage of this study is that relatively few cases have been collected and there is a lack of severe and critical cases.

Conclusions

In the early stage of COVID-19, the WBC and LYM in moderate patients were significantly decreased within 4 days after onset, and could be restored to normal level after 4-7 days. However, no dynamic changes were observed in mild patients within 7 days. It provides help for clinical diagnosis and treatment. According to the dynamic change of WBC and LYM, we speculate that sustained and severe immune injury may be essential for the occurrence of severe cases.

Competing Interests

The authors have declared that no competing interests exist.

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