

Часть пострадавших (n=11), учитывая тяжесть травматического шока, в ряде случаев сочетающегося с отеком головного мозга в результате ЧМТ, была переведена на принудительную ИВЛ с медикаментозной синхронизацией (до момента оперативного вмешательства), продолжающуюся в течение всего времени проведения интенсивной терапии.

Выводы:

1. Использование кристаллоидных растворов, как инфузионных сред первого выбора у пациентов с тяжелой скелетной травмой, сопровождающейся травматическим шоком, может позволить стабилизировать системную гемодинамику в более короткие сроки относительно применения коллоидных растворов при интенсивной терапии данного рода повреждений.
2. Стабилизация системной гемодинамики и своевременный перевод пострадавших с тяжелой скелетной травмой позволяет предупредить развитие тяжелой гипоксемии и переход травматического шока в стадию декомпенсации.

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How informative are the leukocyte formula and ESR for COVID-19 patients' monitoring?

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Аннотация

Для динамического наблюдения за эффективностью лечения пациентов с новой коронавирусной инфекцией необходимы простые и показательные методики. Клинический анализ крови является первым и обязательным обследованием пациентов. В статье анализируются параметры лейкоцитарной формулы и скорости оседания

эритроцитов (СОЭ) у пациентов COVID-19 до лечения и с 1-го по 15-й день стандартного лечения. При поступлении в стационар регистрировали лимфоцитопению, нейтрофилез и увеличение СОЭ. Статистически значимые отклонения проявлялись на 10-е сутки лечения в повышении абсолютного содержания лейкоцитов при имеющейся лейкопении. За время лечения наблюдали увеличение количества пациентов с нормальными показателями СОЭ, снижением нейтрофилеза, лейкопении и лимфопении, но статистически значимых отличий не выявлено.

Ключевые слова: COVID-19, лейкоцитарная формула, скорость оседания эритроцитов.

Abstract

To provide dynamic monitoring of the treatment effectiveness in the case of patients with a new coronavirus infection, it is important to consider that simple and illustrative methods are needed. A clinical blood test is the first and mandatory patients' examination. This article presents the analysis of the leukocyte formula parameters and the erythrocyte sedimentation rate (ESR) in COVID-19 patients before treatment and during the period from the 1st to the 15th day of standard treatment. Therefore, lymphocytopenia, neutrophilosis, and increased ESR were recorded upon the patients' admission to the hospital. Statistically significant deviations were manifested on the 10th day of treatment in the absolute WBC count increase in the case of existing leukopenia. During treatment, an increase in the number of patients with normal ESR, as well as a decrease in neutrophilosis, leukopenia and lymphopenia was observed, but no statistically significant differences were found.

Keywords: COVID-19, leucogram, erythrocyte sedimentation rate

Relevance. The severity of COVID-19 varies from an asymptomatic disease course to severe damage of lungs and other organs and systems with the phenomena of acute respiratory distress syndrome (ARDS). The development of ARDS in viral lung disease is 3-4%, but this condition may also lead to multiple organ failure and death [1, 2].

The clinical disease symptoms include fever (78.9% of patients), acute respiratory symptoms (67.7%), dyspnea (18.6%), dyspepsia (5%), diarrhoea (3.7%), and general symptoms of intoxication — weakness (38.1%), headache (13.6%). Viral lung damage with the development of pneumonia occurs in 76% of cases, the development of hypoxia – in 38% [3].

An important factor in the provision of medical care to inpatient patients with COVID-19 is the assessment of the dynamics of clinical and laboratory parameters. The severity of changes in some of them is closely related to the severity of the disease [4, 5].

The literature data indicate a variety of deviations in the clinical blood test. Most of the patients have a normal number of leukocytes, about 30% suffer from leucopenia and 83.2% – from lymphopenia [1, 4, 6, 7]. The COVID-patients are also characterized by lymphopenia and neutrophilosis, according to E. A. Borodulina et al., 2021, V. Y. Mareeva et al., 2020, but in more than half of the cases, the general blood test values are within the reference values.

It was shown in the studies of S. Tan et al., 2000, R. K Mahat. et al., 2021, that ESR and the granulocyte/lymphocyte ratio are positively associated with the severe condition of patients according to clinical manifestations and computed tomography. In contrast, the number of lymphocytes has a negative correlation. Certainly, all the authors come to the conclusion that a timely assessment of hematological parameters makes it possible to prescribe intensive treatment in time and reduce mortality among the patients with a new coronavirus infection.

Therefore, the **aim** is to study the dynamics of the leukocyte formula and ESR parameters in patients with a new coronavirus infection during standard treatment.

Materials and methods. The authors examined 70 patients who were admitted to the COVID-19 infectious diseases department with a severe and extremely severe disease course. All the patients received standard treatment in accordance with the Interim Guidelines: Prevention, Diagnosis and Treatment of the Novel Coronavirus Infection (COVID-19), version 10 dated 08.02.2021 [1].

Laboratory parameters of clinical blood test were studied as well: absolute leukocyte count (absolute WBC count), lymphocytes and neutrophils percentage, ESR. The study was performed before treatment and on the 1st, 5th, 10th, 15th day during treatment.

The authors used the program @medstatistic for statistical data processing and sample size calculation. The arithmetic mean (M) and standard deviation ($\pm m$) were used. The significance level (p) was calculated by means of using the Student's t-test. The $p < 0.05$ level was considered as a statistically significant one.

Results and discussion. There were 39 men (56%) and 31 women (44%) in the study group, the age of patients was 59.2 ± 10.4 (from 21 to 77 years). The disease was severe in 54 people (77 %) and extremely severe – in 16 people (23%). Fifty-four patients (77%) had a positive PCR test for the detection of SARS-CoV-2 virus RNA, 16 (23 %) had a negative one. The X-ray examination (computed tomography, radiography) of the chest organs revealed bilateral viral lung damage in all the patients.

The study of the clinical blood test parameters demonstrated that the CLYM corresponded to normal values before treatment and on the 1st day of therapy. As for the leukocytosis, it was observed on the 5th and 10th days. The values returned to the reference values by the 15th day of treatment.

Leukopenia occurred in 10.9% of patients before treatment, and in 3.3%-12.5% cases it happened during treatment. The maximum value was reached by the 15th day – $2.5 \pm 2.9 \times 10^9/l$. According to X. Xu et al., 2020, on the 5th day after treatment, leukopenia up to $5.25 \pm 2.11 \times 10^9/l$ was observed in 10.5%. In this certain study, leukopenia up to $4.0 \pm 0.7 \times 10^9/l$ occurred in 7.6% of patients on the 5th day of treatment. Leukocytosis was registered before treatment in 32.8% of patients, with fluctuations during treatment from 27.2% to 53.8%, with the maximum fluctuation of values by the 10th day ($19.2 \pm 7.1 \times 10^9/l$) and a decrease in values to $13.9-15.1 \times 10^9/l$ on the 15th day (Table. 1).

Table 1.

WBC count values in patients suffering from COVID-19.

Values, ref. range, $4.8-10.8 \times 10^9/l$	Before treatment	1 day	p	5 days	p	10 days	p	15 days	p
Leukocytes, average values, $\times 10^9/l$ M \pm m	9.9 \pm 3.8	9.4 \pm 4.4	0.9	12.8 \pm 9.6	0.7	11.8 \pm 7.1	0.8	8.8 \pm 4.5	0.8
Leukopenia number of patients, % value, $\times 10^9/l$ M \pm m	10.9 4.0 \pm 0.2	9.6 3.3 \pm 0.8	0.4	7.6 4.0 \pm 0.7	1.0	3.3 4.7	0.01	12.5 2.5 \pm 2.9	0.6
Leukocytosis, number of patients, % value, $\times 10^9/l$ M \pm m	32.8 13.8 \pm 3.3	32.6 14.1 \pm 3.9	0.9	53.8 17.5 \pm 11.1	0.7	36.6 19.2 \pm 7.1	0.4	37.5 13.9 \pm 1.8	0.9

The average values of the lymphocytes number (norm – 19-37%) were reduced both before treatment and on the 1st, 5th, 10th, 15th day of therapy. The maximum decrease in lymphocytes occurred on the 5th day and was 10.7±8.2%.

Lymphopenia occurred before treatment in 90.6% of patients, on the 1st day of treatment in 88.4%, decreasing to 75.0% by the 15th day. The values corresponded to 10.1±4.0 % before treatment, 9.7±3.3% on the 1st day, and 9.6±5.3% on the 15th day. Lymphocytosis occurred only on the 1st day after the beginning of treatment in 3.8% of patients and amounted to 42.5±0.7 %. According to X. Xu et al., 2020, lymphocytes returned to normal values in 52.6% (on average, 22.62±13.48×10⁹/l) by the 5th day of treatment. According to the authors' data, lymphopenia persisted in 72% of patients by the 5th day of treatment (Table 2).

Table 2.

Lymphocytes count values in patients suffering from COVID-19.

Values, ref. range 19%-37%	Before treatment	1 day	p	5 days	p	10 days	p	15 days	p
Lymphocytes, average values, % M±m	11.3±5.6	12.3±8.6	0.9	10.7±8.2	0.9	12.6±8.9	0.9	12.0±7.6	0.9
Lymphopenia, number of patients, % value, % M±m	90.6 10.1±4.0	88.4 9.7±3.3	0.9	72.0 6.3±2.4	0.4	76.6 8.6±4.7	0.8	75.0 9.6±5.3	0.9
Lymphocytosis, number of patients, % value, % M±m	- -	3.8 42.5±0.7		- -		- -		- -	

The average neutrophils count values were higher than the reference values both before treatment (83.1±6.2%) and during therapy. Neutropenia was not observed during the entire observation period. Neutrophilosis was observed before treatment in 85.7% of patients and decreased to 75.0% by the 15th day. The values were 84.1±5.0% before treatment, 84.2±4.1% on the 1st day of treatment, and 83.5±6.0% on the 15th day (Table 3).

Table 3.

Neutrophils count values in patients suffering from COVID-19.

Values, ref. range 41-72%	Before treatment	1 day	p	5 days	p	10 days	p	15 days	p
Neutrophils, average values, % M±m	83.1±6.2	80.6±10.5	0.8	83.0±8.0	0.9	78.9±12.6	0.7	78.3±10.8	0.7
Neutropenia, number of patients, % value, % M±m	- -	- -		- -		- -		- -	
Neutrophilosis, number of patients, % value, % M±m	85.7 84.1±5.0	86.2 84.2±4.1	0.9	84.6 85.4±5.9	0.8	63.3 86.5±4.7	0.7	75.0 83.5±6.0	0.9

The average ESR values over the entire follow-up period were higher than the reference values (norm – 0-15 mm/h): they were 41.4 ± 13.6 mm/hour before treatment, 38.5 ± 14.5 mm/hour on the 1st day after the beginning of therapy and decreased to 25.0 ± 23.5 mm/h by the 15th day. In 5.4% of patients, ESR occurred within the normal range before treatment, it was 6.1% on the 1st day after administration, then increased to 57.1% by the 15th day (Table 4).

Table 4.

ESR values in patients suffering from COVID-19.

Values, ref. range 0-15 mm/h	Before treatment	1 day	p	5 days	p	10 days	p	15 days	p
ESR, average values, mm/h M \pm m	41.4 \pm 13.6	38.5 \pm 14.5	0.8	25.4 \pm 16. 0	0.4	20.2 \pm 15. 0	0,2	16.5 \pm 12. 6	0.1
Normal ESR, number of patients, %	5.4	6.1	-	30.4	-	45.4	-	57.1	-

Conclusions.

1. The statistically significant deviations in the parameters of the leukocyte formula and ESR in COVID-19 patients during standard treatment were manifested in the WBC count increase on the 10th day with existing leukopenia.
2. The increase in the number of patients with normal ESR, decreased neutrophilosis and lymphopenia by the 15th day of treatment was not accompanied by any statistically significant changes.

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