UDC: 616.98:578.834+616-001.28

CLINICAL AND LABORATORY EFFECTS OF TREATING PATIENTS WITH CORONAVIRUS INFECTION AND THEIR SIGNIFICANCE FOR POST-COVID OUTCOMES

Agzamkhodjaeva N.U.[1], Islamova R.K.[1], Ruzibakieva M.R.[2], Abidova D.E.[3]
[1] Profi University, Tashkent.
[2] Institute of Human Immunology and Genomics, Academy of Sciences of the Republic of Uzbekistan, Tashkent.
[3] Republican Specialized Scientific-Practical Medical Center of Cardiology, Tashkent.

КЛИНИЧЕСКИЕ И ЛАБОРАТОРНЫЕ ЭФФЕКТЫ ЛЕЧЕНИЯ ПАЦИЕНТОВ С КОРОНАВИРУСНОЙ ИНФЕКЦИЕЙ И ИХ ЗНАЧЕНИЕ ДЛЯ ПОСТ-COVID ИСХОДОВ

Агзамходжаева Н.У.[1], Исламова Р.К.[1], Рузибакиева М.Р.[2], Абидова Д.Э.[3]
[1]Profi University, Ташкент.
[2]Институт иммунологии и геномики человека АН РУз, Ташкент.
[3]Республиканский специализированный научно-практический медицинский центр кардиологии, Ташкент.

KORONAVIRUS INFEKTSIYASI BILAN KASALLANGAN BEMORLARNI DAVOLASHNING KLINIK VA LABORATOR TA'SIRLARI VA ULARNING POST-COVID NATIJALARI UCHUN AHAMIYATI

Agzamkhodjaeva N.U.[1], Islamova R.K.[1], Ruzibakieva M.R.[2], Abidova D.E.[3]
[1] Profi University, Tashkent.
[2] Institute of Human Immunology and Genomics, Academy of Sciences of the Republic of Uzbekistan, Tashkent.
[3] Republican Specialized Scientific-Practical Medical Center of Cardiology, Tashkent.

Abstract. *Despite the accumulated clinical experience, the influence of therapeutic approaches used in the acute phase of COVID-19 on the development of long-term post-COVID consequences remains insufficiently studied. The aim of the study is to evaluate the clinical and laboratory effectiveness of different antiviral regimens in the acute phase of the disease and to determine their significance as factors influencing the formation of post-COVID complications, particularly in patients with arterial hypertension and high cardiovascular risk.*
Keywords: *COVID-19, post-COVID syndrome, antiviral therapy, monoclonal antibodies, arterial hypertension, clinical and laboratory effects.*

Аннотация. *Несмотря на накопленный клинический опыт, влияние терапевтических подходов, применяемых в острой фазе COVID-19, на развитие долгосрочных пост-COVID последствий остаётся недостаточно изученным. Цель исследования — оценить клиническую и лабораторную эффективность различных схем противовирусного лечения в остром периоде заболевания и определить их роль как факторов, влияющих на формирование пост-COVID осложнений, особенно у пациентов с артериальной гипертензией и высоким сердечно-сосудистым риском.*
Ключевые слова: *COVID-19, пост-COVID синдром, противовирусная терапия, моноклональные антитела, артериальная гипертензия, клинические и лабораторные эффекты.*

Annotatsiya. *To‘plangan klinik tajribaga qaramay, COVID-19 ning o‘tkir bosqichida qo‘llaniladigan terapevtik yondashuvlarning uzoq muddatli post-COVID oqibatlar rivojlanishiga ta’siri yetarli darajada o‘rganilmagan. Tadqiqotning maqsadi — kasallikning o‘tkir davrida turli antiviral davolash sxemalarining klinik va laborator samaradorligini baholash hamda ularning post-COVID asoratlar shakllanishiga ta’sirini, xususan arterial gipertenziya va yuqori yurak-qon tomir xavfi bo‘lgan bemorlarda aniqlashdan iborat.*
Kalit so‘zlar: *COVID-19, post-COVID sindromi, antiviral terapiya, monoklonal antitelalar, arterial gipertenziya, klinik va laborator ta’sirlar.*

Actuality. Despite the accumulated clinical experience in treating the novel coronavirus infection [5, 8], the impact of various therapeutic approaches during the acute phase of the disease on the development of long-term post-COVID consequences remains insufficiently studied [9, 11,15]. Most early research focused on reducing mortality and the severity of acute COVID-19 [13], while long-term outcomes, including the risk of developing post-COVID syndrome, remained outside the scope of attention for a considerable time [12,14, 20]. Of particular interest is the evaluation of the effectiveness of combined therapeutic regimens, including antiviral drugs and monoclonal antibodies, in patients with high cardiovascular risk [17]. The presence of arterial hypertension and other cardiovascular diseases is considered a significant factor contributing both to the severe course of acute infection and to the persistence of post-COVID symptoms [5, 8].

In this regard, a comprehensive analysis of clinical, laboratory, and immunological parameters in patients with COVID-19 during the acute phase of the disease, depending on the therapeutic regimens applied, appears to be highly relevant [21].

Aim of the study. The aim of the present study was to evaluate the clinical and laboratory effectiveness of different therapeutic regimens administered during the acute phase of COVID-19 and to determine their potential role as factors influencing the development of post-COVID complications in the subsequent follow-up period.

Materials and methods. Study design and study population. This study was designed as a prospective observational investigation conducted between 2020 and 2023. A total of 302 patients with a confirmed diagnosis of COVID-19 were enrolled. Patient age ranged from 19 to 80 years and older, reflecting the real-world demographic

structure of hospitalized patients with coronavirus infection. The diagnosis of COVID-19 was established based on a positive reverse transcription polymerase chain reaction (RT-PCR) test for SARS-CoV-2 and/or characteristic findings on chest computed tomography, including bilateral ground-glass opacities and other patterns consistent with viral pneumonia.

All patients were hospitalized during the acute phase of the disease and received standardized clinical monitoring throughout the treatment period. Depending on the antiviral strategy used, patients were allocated into four therapeutic groups. Group 1 included patients treated with remdesivir as part of standard antiviral therapy. Group 2 consisted of patients receiving favipiravir. Group 3 comprised patients treated with a combination of favipiravir and monoclonal antibodies targeting the SARS-CoV-2 spike protein (casirivimab and imdevimab). Group 4 included patients who received remdesivir in combination with monoclonal antibody therapy. The choice of treatment regimen was based on national clinical guidelines in force at the time of patient inclusion and took into account disease severity, comorbid conditions, and contraindications to specific drugs.

Given the high prevalence and clinical relevance of cardiovascular comorbidities in patients with COVID-19, an additional stratification was performed according to the presence or absence of concomitant arterial hypertension. This approach allowed for a more detailed assessment of the influence of baseline cardiovascular status on treatment response and on the formation of conditions potentially predisposing to post-COVID complications. Clinical assessment during hospitalization included daily evaluation of vital parameters, such as oxygen saturation, heart rate, respiratory rate, body temperature, and arterial blood pressure. Laboratory investigations encompassed complete blood count, routine biochemical tests, inflammatory markers, and coagulation parameters, enabling comprehensive monitoring of systemic inflammatory response and treatment dynamics. The applied methodological framework ensured comparability between groups and provided a robust basis for subsequent analysis of clinical and laboratory effects associated with different therapeutic strategies (Table 1).

Clinical and Demographic Characteristics of Patients and Distribution by Therapeutic Groups.

Table 1.

Age	remdesivir *(n=97)*	favipiravir *(n=55)*	favipiravir+*mAb* *(n=52)*	remdesivir+*mAb* *(n=98)*
19–29 лет	12 (12,4%)	17 (30,9%)	9 (17,3%)	4 (4,1%)
30–39 лет	19 (19,6%)	12 (21,8%)	18 (34,6%)	6 (6,1%)
40–49 лет	13 (13,4%)	13 (23,6%)	12 (23,1%)	17 (17,3%)
50–59 лет	27 (27,8%)	12 (21,8%)	8 (15,4%)	17 (17,3%)
60–69 лет	23 (23,7%)	8 (14,5%)	7 (13,5%)	35 (35,7%)
70–79 лет	3 (3,1%)	4 (7,3%)	6 (11,5%)	15 (15,3%)
80 лет +	0 (0,0%)	0 (0,0%)	2 (3,8%)	4 (4,1%)
male	52 (53,6%)	27 (49,1%)	22 (42,3%)	58 (59,2%)
female	45 (46,4%)	28 (50,9%)	30 (57,7%)	40 (40,8%)
total patients	97 (100%)	55 (100%)	52 (100%)	98 (100%)

Methods of Clinical and Laboratory Assessment. During hospitalization, all patients underwent dynamic clinical evaluation, including regular recording of body temperature, respiratory rate, heart rate, oxygen saturation, and arterial blood pressure.Laboratory assessment comprised complete blood count and biochemical blood analysis, evaluation of inflammatory markers (C-reactive protein and interleukin-6), parameters of the hemostatic system (D-dimer), as well as immunological markers, including IgM and IgG antibodies to SARS-CoV-2.

Instrumental diagnostics included multislice computed tomography of the chest with assessment of the extent of lung parenchymal involvement.

Statistical data processing was performed using standard methods of variation statistics. Quantitative variables were presented as mean ± standard deviation (M±SD) or as median with interquartile range, depending on data distribution. Intergroup comparisons were conducted using Student's t-test and the chi-square (χ^2) test. Differences were considered statistically significant at $p<0.05$.

Results. Analysis of baseline clinical and demographic characteristics demonstrated comparability of the study groups in terms of age, sex, and severity of pulmonary involvement. The prevalence of concomitant arterial hypertension was 49.7% [8], reflecting the real-world structure of hospitalized patients with COVID-19.

Dynamics of Clinical Indicators During Hospitalization

Against the background of ongoing therapy, all groups demonstrated positive dynamics of clinical indicators; however, the most pronounced improvement was observed in patients receiving combination regimens that included monoclonal antibodies. In these groups, oxygen saturation recovery occurred more rapidly, and hemodynamic parameters stabilized sooner (Table 2).

Changes in Major Vital Parameters.

Table 2.

Parameter		remdesivir *(n=97)*	favipiravir *(n=55)*	favipiravir+*mAb* *(n=52)*	remdesivir+*mAb* *(n=98)*
Saturation % before	M±SD	91,01±1,50	92,05±1,18	91,41±12,23	90,77±9,04
	Median (min–max)	91 (88–96)	92 (86–93)	93 (1,14–95)	92 (1,52–94)
p		*<0,001*	*<0,001*	*0,086*	*0,005*
Saturation % before	M±SD	93,34±2,05	94,22±1,20	95,29±12,74	94,52±9,45
	Median (min–max)	94 (88–99)	95 (90–96)	97 (1,52–99)	96 (2,04–98)
Pulse before, bpm	M±SD	97,74±9,06	98,84±9,13	101,27±16,14	103,62±12,99
	Median (min–max)	96 (70–122)	96 (78–122)	102 (9,61–125)	102 (8,65–124)
p		*<0,001*	*<0,001*	*<0,001*	*<0,001*
Pulse after, bpm	M±SD	83,01±6,33	85,15±6,36	81,24±12,34	80,78±10,82
	Median (min–max)	82 (64–102)	85 (72–102)	82 (6,94–98)	80 (7,58–107)
Temperature °C before	M±SD	37,48±0,63	37,61±0,47	37,16±4,97	37,35±3,70
	Median (min–max)	37,5 (36,2–39,2)	37,6 (36–39,5)	37,7 (0,41–38,5)	37,6 (0,44–39,0)
p		*<0,001*	*<0,001*	*0,338*	*0,042*
Temperature °C after	M±SD	36,53±0,29	36,48±0,25	36,55±0,17	36,28±3,60
	Median (min–max)	36,5 (35,8–38,3)	36,5 (35,8–37,1)	36,6 (36,0–36,8)	36,6 (0,16–37,6)

Note: p — the level of statistical significance of differences between values in dynamics within each group (statistically significant at p<0.05).

In patients with concomitant arterial hypertension, combination therapy was associated with earlier achievement of target blood pressure values.

Analysis of laboratory data showed that the use of monoclonal antibodies was accompanied by a more pronounced decrease in C-reactive protein, interleukin-6, and D-dimer levels. This dynamic indicates more effective suppression of the systemic inflammatory response and reduced activity of the coagulation cascade (Table 3). Immunological analysis demonstrated a more favorable profile of humoral response in patients receiving combination therapy, which may be relevant for subsequent post-COVID outcomes.

Dynamics of Major Inflammatory and Coagulation Blood Parameters.

Table 3.

Parameter		remdesivir *(n=97)*	favipiravir *(n=55)*	favipiravir+*mAb* *(n=52)*	remdesivir+*mAb* *(n=98)*
CRP before	M±SD	27,55±32,29	32,12±36,18	37±39	44,95±40,62
	Median (min–max)	13,5 (0,4–245,1)	16,4 (0,5–183,0)	23,4 (0,9–165)	36,2 (0,5–184,3)
p		*<0,001*	*0,004*	*0,005*	*<0,001*
CRP after	M±SD	10,47±16,42	14,90±22,73	20,8±25,4	19,26±27,32
	Median (min–max)	3,0 (0,1–100,5)	4,6 (0,4–126,0)	23,45 (0,9–165)	10,6 (0,30–120,3)
D-dimer before	M±SD	384,98±522,24	460,38±610,43	517±711	364,29±417,21
	Median (min–max)	235,6 (17,1–3161,5)	295 (20–3340)	253 (33–2986)	217 (16,8–1765)
p		*0,024*	*0,11*	*0,12*	*0,0002*
D-dimer after	M±SD	237,18±370,70	300,32±412,50	300,32±412,50	184,58±215,87
	Median (min–max)	135,6 (10,2–2386)	184 (15–2520)	184 (15–2520)	96,6 (36,3–878,8)
Ferritin before	M±SD	377,63±360,21	370,6±370,9	316,1±364,1	299,7±348,7
	Median (min–max)	246 (2,8–1645)	223 (9,21–1893)	191 (5,35–1556)	246 (10,8–2011)
p		*0,0012*	*0,042*	*0,037*	*0,068*

Ferritin after	M±SD	515,37±482,98	448,2±431,4	398,5±494,0	397,2±522,5
	Median (min–max)	286 (6,49–2138)	231 (8,3–2471)	197,5 (14,5–1998)	212 (2,89–2376)
Procalcitonin before	M±SD	0,31±1,31	0,17±0,26	0,40±0,80	0,10±0,10
	Median (min–max)	0,09 (0,01–8,06)	0,05 (0,01–1,2)	0,09 (0,01–2,87)	0,03 (0,01–0,64)
p		0,023	0,041	0,089	0,119
Procalcitonin after	M±SD	0,53±9,92	0,13±0,17	0,20±0,20	0,10±0,10
	Median (min–max)	0,10 (0,01–100,0)	0,05 (0,01–0,76)	0,11 (0,01–0,76)	0,05 (0,0–0,38)
interleukin-6 before	M±SD	11,62±13,74	12,57±14,55	10,0±11,6	18,8±21,6
	Median (min–max)	4,80 (0,20–70,30)	7,0 (0,33–81,06)	5,48 (0,59–43,7)	11,11 (0,74–99,5)
p		<0,001	0,053	0,072	0,145
interleukin-6 after	M±SD	5,48±10,02	6,62±10,38	5,5±11,0	10,6±33,1
	Median (min–max)	1,42 (0,01–96,0)	1,66 (0,01–64,9)	1,63 (0,06–43,4)	1,44 (0,05–177)

Note: p — the level of statistical significance of differences between values in dynamics within each group (statistically significant at p<0.05.

According to chest MSCT data, patients receiving monoclonal antibodies demonstrated a more rapid reduction in the volume of lung tissue involvement. The proportion of patients with pronounced positive radiological dynamics was significantly higher in the combination therapy groups (Table 4).

General indicators of treatment effectiveness.

Table 4.

Parameter		remdesivir *(n=97)*	favipiravir *(n=55)*	favipiravir+*mAb* *(n=52)*	remdesivir+*mAb* *(n=98)*
MSCT before, %	M±SD	12,34±6,22	11,35±5,72	12,37±9,04	17,51±10,7
	Median (min–max)	10 (2–35)	10 (2–30)	10 (3–45)	15 (2–48)
p		*0,001*	*0,004*	*<0,0001*	*<0,0001*
MSCT after, %	M±SD	8,91±7,88	7,92±6,48	2,31±3,87	6,59±8,3
	Median (min–max)	8 (0–40)	6 (0–32)	0 (0–15)	5 (0–45)
Adverse events ≤ 24 h	M±SD	1,08±0,28	1,05±0,23	1,02±0,14	1,01±0,1
	Median (min–max)	1 (1–2)	1 (1–2)	1 (1–2)	1 (1–2)
Evaluation of treatment effectiveness Scores	M±SD	2,66±0,58	2,75±0,5	2,96±0,19	2,79±0,52
	Median (min–max)	3 (1–3)	3 (1–3)	3 (2–3)	3 (0–3)
Tolerance assessment Scores	M±SD	3,90±0,39	3,87±0,45	3,88±0,33	3,87±0,37
	Median (min–max)	4 (1–4)	4 (2–4)	4 (3–4)	4 (2–4)
Days of treatment	M±SD	12,44±3,88	11,90±3,72	11,95±3,66	9,85±2,81
	Median (min–max)	12 (6–24)	12 (6–23)	12 (6–23)	9 (2,5–20)

Note: p — the level of statistical significance of differences between values in dynamics within each group (statistically significant at p<0.05).

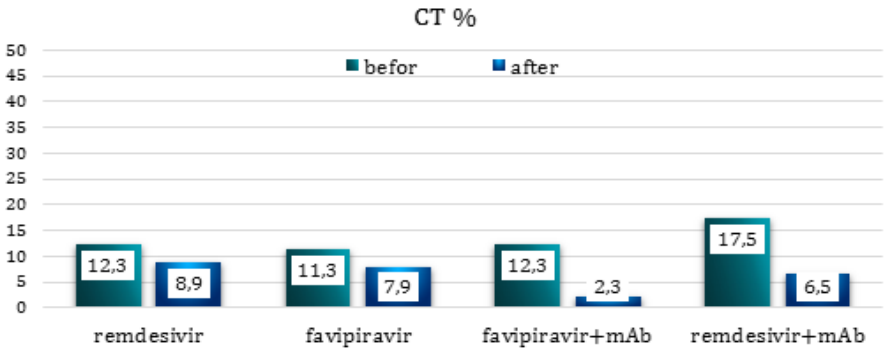


Figure 1. Dynamics of lung involvement according to MSCT data.

Dynamics of lung involvement according to MSCT data, where the diagram shows that the best recovery result of lung lesions was observed in the group treated with antiviral drugs in combination with monoclonal antibodies (Figure 1)

The obtained data indicate that the choice of therapeutic strategy in the acute phase of COVID-19 has a significant impact on clinical and laboratory parameters and may create prerequisites for the development or, conversely, prevention of post-COVID complications [11, 15]. A particularly significant effect of combination therapy was revealed in patients with arterial hypertension [5, 8], which emphasizes the need for an individualized approach to the treatment of this category of patients.

Conclusions. Combination therapy regimens for COVID-19 that include monoclonal antibodies are characterized by higher clinical and laboratory effectiveness compared to standard antiviral therapy [9, 12].

The use of monoclonal antibodies is associated with a more pronounced reduction in markers of systemic inflammation and coagulation [17]. In patients with arterial hypertension, combination therapy contributes to faster clinical improvement and stabilization of hemodynamic parameters [5,8].

The obtained results substantiate the feasibility of applying personalized therapeutic approaches in the acute phase of COVID-19 to reduce the risk of developing post-COVID complications [14, 20, 21].

References:

1. Абдульянов И.В., Амиров Н.Б., Гайсин М.Р., Каипов А.Э., Абдрахманова А.И. Роль микроРНК в развитии фибрилляции предсердий у пациентов с клапанной патологией сердца // Кардиоваскулярная терапия и профилактика. – 2020. – Т.19, №5. – С.142–150.
2. Айтбаев К.А., Муркамилов И.Т., Фомин В.В. Циркулирующие микроРНК как потенциальные биомаркеры хронической болезни почек // Терапевтический архив. – 2019. – Т.91, №6. – С.133–138.
3. Арутюнов А.К., Мартыненко А.В. Критерии отбора пациентов с острым кардиологическим событием для коррекции стрессоустойчивости и социальной адаптации в период пандемии COVID-19 // Вестник Волгоградского государственного медицинского университета. – 2021. – №2(78). – С.160–164.
4. Арутюнов Г.П., Костюкевич О.И. Постковидный синдром: клинические аспекты и подходы к реабилитации // Терапевтический архив. – 2021. – Т.93, №9. – С.102–110.
5. Бойцов С.А., Драпкина О.М. COVID-19 и сердечно-сосудистая система: от острого поражения к отдалённым последствиям // Кардиология. – 2021. – Т.61, №6. – С.4–12.
6. Мартынов А.И., Моисеев С.В. Постковидные состояния: клиническая характеристика и нерешённые вопросы // Клиническая медицина. – 2021. – №99(8). – С.5–12.
7. Рузибакиева М.Р., Абидова Д.Э., Агзамходжаева Н.У. Долгосрочные последствия COVID-19: клинико-функциональная динамика Long COVID и сердечно-сосудистых осложнений // Илм-фан хабарномаси. – 2025. – №11. – С.4481–4485.
8. Чазова И.Е., Жернакова Ю.В. Артериальная гипертензия и COVID-19: клинические уроки пандемии // Системные гипертензии. – 2021. – №2. – С.5–12.
9. Carfì A., Bernabei R., Landi F. Persistent symptoms in patients after acute COVID-19 // JAMA. – 2020. – Vol.324(6). – P.603–605.
10. Crook H., Raza S., Nowell J., Young M., Edison P. Long COVID—mechanisms, risk factors, and management // BMJ. – 2021. – Vol.374. – n1648.
11. Davis H.E., McCorkell L., Vogel J.M., Topol E.J. Long COVID: major findings, mechanisms and recommendations // Nature Reviews Microbiology. – 2023. – Vol.21. – P.133–145.
12. Greenhalgh T., Knight M., A'Court C., Buxton M., Husain L. Management of post-acute COVID-19 in primary care // BMJ. – 2020. – Vol.370. – m3026.
13. Huang C., Huang L., Wang Y. et al. 6-month consequences of COVID-19 in patients discharged from hospital // The Lancet. – 2021. – Vol.397. – P.220–232.
14. Lopez-Leon S., Wegman-Ostrosky T., Perelman C. et al. More than 50 long-term effects of COVID-19: a systematic review // Scientific Reports. – 2021. – Vol.11. – 16144.
15. Nalbandian A., Sehgal K., Gupta A. et al. Post-acute COVID-19 syndrome // Nature Medicine. – 2021. – Vol.27. – P.601–615.
16. National Institutes of Health (NIH). Post-Acute Sequelae of SARS-CoV-2 Infection (PASC). – NIH, 2022.
17. Puntmann V.O., Carerj M.L., Wieters I. et al. Outcomes of cardiovascular magnetic resonance imaging in patients recently recovered from COVID-19 // JAMA Cardiology. – 2020. – Vol.5(11). – P.1265–1273.
18. Sudre C.H., Murray B., Varsavsky T. et al. Attributes and predictors of long COVID // Nature Medicine. – 2021. – Vol.27. – P.626–631.
19. Vabret N., Britton G.J., Gruber C. et al. Immunology of COVID-19: current state of the science // Nature Reviews Immunology. – 2020. – Vol.20. – P.363–374.
20. World Health Organization. A clinical case definition of post COVID-19 condition by a Delphi consensus. – WHO, 2021.
21. Xiong Q., Xu M., Li J. et al. Clinical sequelae of COVID-19 survivors // Clinical Microbiology and Infection. – 2021. – Vol.27. – P.89–95.
22. Yong S.J. Long COVID or post-COVID-19 syndrome: putative pathophysiology and risk factors // Medical Hypotheses. – 2021. – Vol.149. – 110538.