Research Article

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The Impact of Vaccination on Disease Course and Outcome in Intensive Care Patients With COVID-19

B.L. Kurilin ✉, V.Y. Kiselevskaya-Babinina, Y.V. Kuzmicheva, A.V. Shapoval, N.E. Drozdova, K.A. Popugayev

Specialized Medical Care Teams for Emergency Situations
N.V. Sklifosovsky Research Institute for Emergency Medicine
3, B. Sukharevskaya Sq., Moscow, 129090, Russian Federation

✉ **Contacts:** Boris L. Kurilin, Epidemiologist of Specialized Medical Care Teams for Emergency Situations, N.V. Sklifosovsky Research Institute for Emergency Medicine.
Email: kurilinbl@sklif.mos.ru

BACKGROUND Our study provides a unique opportunity to compare the course of the disease with a new coronavirus infection in seriously ill patients in the groups of vaccinated and unvaccinated patients hospitalized in the infectious intensive care units of N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department since the start of the vaccination campaign.

AIM OF STUDY The study of the composition of hospitalized patients with COVID-19 in the N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department in serious condition, requiring resuscitation, in groups of vaccinated and unvaccinated patients in terms of their age and gender characteristics, the severity of the condition and duration of treatment, the presence of concomitant (chronic) diseases, as well as the outcome of hospitalization.

MATERIAL AND METHODS The initial analyzed material was data from the Unified Medical Information and Analytical System (UMIAS) of the Institute and statistical cards of patients who left the hospital.

The formation of the main group of vaccinated patients was carried out in accordance with the instructions of the Moscow Department of Health and in pursuance of the letter of the Office of Rospotrebnadzor for the city of Moscow No. I-17-17/1 dated January 26, 2021 "On monitoring COVID-19 cases in those vaccinated against a new coronavirus infection ". The Institute has created a registry of hospitalized patients diagnosed with Coronavirus infection caused by the COVID-19 virus, who have a certificate of vaccination with registration in UMIAS. Also, to determine vaccinated patients, we used information from the Headquarters for measures to prevent the importation and spread of infection caused by the 2019-nCoV coronavirus in the city of Moscow.

The comparison group included patients with coronavirus infection caused by the SARS-CoV-2 virus, hospitalized in the infectious diseases intensive care units of the Institute and not having information about the certificate in UMIAS.

The analyzed period was counted from the moment the register was created and amounted to 6 months: from May 1 to October 31, 2021.

Discrete numerical accounting characteristics of each unit of observation (hospitalized patient) were age, duration of stay in the hospital (including in intensive care). Categorical data were gender, diagnosis, source of admission, severity, presence of pneumonia upon admission, history of chronic diseases, outcomes of hospitalization.

After the anonymization of the personal data of patients and the distribution of patients into comparison groups, the obtained information was processed by standard means of mathematical statistics using the R-free software computing environment. The calculation of additional absolute and relative values, average errors of indicators was made. Statistical significance of differences in numerical values was determined using the Student's t-test, categorical values were calculated using the χ^2 test. In both cases, the p-value was chosen to be less than 0.05.

RESULTS When comparing the course of coronavirus infection, concomitant diseases, the duration and nature of inpatient treatment, the frequency of external and internal transfers between different departments, as well as disease outcomes in vaccinated and unvaccinated patients hospitalized at N.V. Sklifosovsky Research Institute for Emergency Medicine of the Moscow Health Department revealed:

- the average duration of stay both in clinical units and in intensive care units in vaccinated patients is significantly less than in unvaccinated patients;
- all patients were admitted to the hospital in a serious or extremely serious condition caused by severe clinical manifestations of coronavirus infection in unvaccinated patients and comorbid diseases in most of the vaccinated patients;
- the mortality among vaccinated patients is significantly lower, and the immediate cause of death was almost always complications of a severe course of competing (non-infectious) diseases.

CONCLUSION The study showed that in vaccinated patients with intense post-vaccination immunity, the risk of developing a severe course of coronavirus infection (requiring resuscitation) is much lower. Along with this, the duration of treatment is also significantly reduced, especially in intensive care units, and the likelihood of an unfavorable outcome of the disease is reduced to a minimum.

Keywords: new coronavirus infection COVID-19, SARS-CoV-2, vaccination, post-vaccination immunity, comorbidity, complications

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Affiliations

Boris L. Kurilin	Epidemiologist of Specialized Medical Care Teams for Emergency Situations, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0003-3019-1947, kurilinвl@sklif.mos.ru; 35%, analysis and interpretation of the results, writing the part of the manuscript
Victoria Y. Kiselevskaya-Babinina	Junior Researcher, Laboratory of Automated Control Systems, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-9057-2162, kiselevskayavy@sklif.mos.ru; 15%, collecting material, writing the part of the manuscript
Yana V. Kuzmicheva	Epidemiologist, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0001-8724-1349, kuzmichevayv@sklif.mos.ru; 15%, analysis and interpretation of the results, writing the part of the manuscript
Anna V. Shapoval	Epidemiologist, N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-3154-2895, shapovalav@sklif.mos.ru; 15%, analysis and interpretation of the results, writing the part of the manuscript
Natalia Y. Drozdova	Deputy Director for Medicine – Chief Physician of N.V. Sklifosovsky Research Institute for Emergency Medicine; drozdovane@sklif.mos.ru; 10%, study design and concept, manuscript editing
Konstantin A. Popugayev	Doctor of Medical Sciences, Professor of the Russian Academy of Sciences, Deputy Director – Head of the Regional Vascular Center of N.V. Sklifosovsky Research Institute for Emergency Medicine; https://orcid.org/0000-0002-6240-820X, popugaevka@sklif.mos.ru; 10%, design and concept of the study, making important comments on the structure of the article

UMIAS - Unified Medical Information and Analytical System
CT - computed tomography
CVD - cardiovascular disease

INTRODUCTION

COVID-19 pandemic is the first large-scale pandemic caused by an emerging respiratory pathogen, the epidemiology and clinical manifestations of which had to be learned as the epidemic process developed both in individual countries and around the world [1]. The rapid spread of the new coronavirus infection COVID-19 has led to the need to increase the mobilization readiness of all medical structures in the country, which has dramatically changed the standard work of all departments of the healthcare system, and this, in turn, has led to large-scale structural changes in the industry. As the epidemic process progressed, the need for an appropriate bed fund increased. In the shortest possible time, it became necessary to deploy a sufficient number of infectious beds to treat patients with COVID-19. Along with the construction of new infectious diseases hospitals, the main method for this was the conversion of existing hospitals that provide medical care in hospitals and do not have infectious diseases departments in their structure, into hospitals with specialized departments that provide assistance in the treatment of patients with a new coronavirus infection COVID- 19 [2–8].

One of the largest multidisciplinary medical organizations providing emergency care in Moscow is the N.V. Sklifosovsky Research Institute for Emergency Medicine (hereinafter the Institute). In order to hospitalize infectious patients as soon as possible for reprofiling, a set of organizational, architectural, planning and sanitary and anti-epidemic measures was developed and implemented. Against this background, an adjustment was also made to the volume of providing narrow- and high-tech specialized, as well as planned medical care [9–12].

Hospitalization of patients with coronavirus infection caused by the SARS-CoV -2 virus to the Institute began on March 20, 2020. In order to organize the admission, hospitalization and treatment of infectious patients, a separate cardiology building was redesigned, a temporary frame-tent structure of the Roder type was built in May 2020, and an observatory for four resuscitation rooms and three hospital beds. The total bed capacity of these units in May 2021 was 43 hospital and 101 intensive care beds.

Due to the fact that more than half of the beds in the departments for the treatment of patients with COVID-19 are resuscitation, and the Institute (in the structure of all hospitals of the Moscow Health Department, converted to treat infectious patients) specializes in admitting patients in serious condition, including with a surgical profile

requiring resuscitation, all patients are hospitalized through intensive care units. As they recover, they are transferred to hospital beds in a temporary frame-tent structure of the Roder type.

Today, there is no etiotropic treatment for COVID-19 with proven clinical efficacy, so the organization of preventive and anti-epidemic measures in places of collective residence, especially in a metropolis, is of particular importance [13, 14]. The most important and most effective anti-epidemic measure to combat COVID-19 at the moment is the vaccination of the population [15, 16]. Since the emergence of COVID-19, vaccines have been developed all over the world, and clinical trials have been conducted to evaluate their effectiveness, safety, and immunogenicity by major pharmaceutical companies [17–20].

Vaccination coverage in the country by the beginning of 2022 amounted to slightly more than 59% of the population, which (even taking into account recovered patients) does not create the possibility of forming herd immunity, when (according to experts) at least 70% of the population must be vaccinated. At the same time, in densely populated cities, where, along with the high virulence and contagiousness of SARS-nCoV-2, the number of contacts among people is much higher, a higher threshold (up to 90% or more) of herd immunity is needed than in sparsely populated areas.

Our study provides a unique opportunity to compare the course of the disease with a new coronavirus infection in seriously ill patients in the groups of vaccinated and unvaccinated patients hospitalized in the infectious diseases intensive care unit of the Institute since the start of the vaccination campaign.

The aim of study: to study the composition of hospitalized patients with COVID-19 in the Institute, who are in serious condition and require resuscitation, in groups of vaccinated and unvaccinated patients in terms of their age and sex characteristics, the severity of the condition and duration of treatment, the presence of concomitant (chronic) diseases, as well as the outcome of hospitalization.

MATERIAL AND METHODS

The initial analyzed material was data from the Unified Medical Information and Analytical System (UMIAS) of the Institute and statistical cards of patients who left the hospital.

The formation of the main group of vaccinated patients was carried out in accordance with the instructions of the Moscow Department of Health and in pursuance of the letter of the Office of Rospotrebnadzor for the city of Moscow No. I-17-17 / 1 dated January 26, 2021 “On monitoring cases of COVID-19 in those vaccinated against a new coronavirus infection ". The Institute has created a registry of hospitalized patients diagnosed with “Coronavirus infection caused by the COVID-19 virus”, who have a certificate of vaccination with registration in UMIAS. Also, information from the Headquarters for measures to prevent the importation and spread of infection caused by the 2019- nCoV coronavirus in Moscow was used to determine vaccinated patients.

The comparison group included patients with coronavirus infection caused by the SARS-CoV -2 virus, who were hospitalized in the infectious diseases intensive care unit of the Institute and did not have information about the certificate in UMIAS.

In addition, the study included cases of hospitalization with comorbidity, where the main diagnosis was COVID-19, but the patient required surgical intervention or therapeutic treatment of another pathology (for example, cardiological, vascular, toxicological, combustiology, etc.). These cases required a more detailed examination with an in-depth analysis of case histories and the formation of a separate group of research objects.

The analyzed period was counted from the moment the register was created and amounted to 6 months: from May 1 to October 31, 2021.

Discrete numerical accounting characteristics of each unit of observation (hospitalized patient) were age, length of stay in the hospital (including in intensive care). Categorical data were gender, diagnosis, channel of hospitalization, severity, presence of pneumonia at admission, history of chronic diseases, outcome of hospitalization.

After anonymizing the patients' personal data and dividing the patients into comparison groups, the obtained information was processed by standard means of mathematical statistics using R, a free software computing environment. The calculation of additional absolute and relative values, average errors of indicators was made. Statistical significance of differences in numerical values was determined using Student's t-test, categorical values — using the χ^2 test. In both cases, the p-value was chosen to be less than 0.05 [21].

RESULTS

There were (n) 1, 981 people in total, 1, 800 unvaccinated (n_1), and 181 vaccinated (n_2). The homogeneity of all patients during hospitalization according to the main diagnosis, severity of the condition, comparability of age groups among vaccinated and unvaccinated was noted. All hospitalized patients required resuscitation and treatment standards provided for by the Interim Guidelines of the Ministry of Health of the Russian Federation "Prevention, diagnosis and treatment of a new coronavirus infection (COVID-19)".

In the group of non-vaccinated patients for a more in-depth study of medical records, taking into account the homogeneity of the entire array of hospitalized, a selective population was determined, which was formed using the method of blind non-repeated mechanical sampling. From the entire array of unvaccinated hospitalized patients during the study period, every 10th case of hospitalization was selected. The final volume of data for the in-depth study was 180 patients.

In the group of vaccinated, subgroups were identified: those vaccinated once (V1), twice (V2), as well as those with a full course of vaccination (V1 + V2) - with a period of developing intense (protective) immunity on the 42nd day from the start of vaccination with a seroconversion level - 95.83%. From this group, patients were isolated up to 6 months and more than 6 months in relation to the time of vaccination, according to the temporary methodological recommendations "Procedure for vaccination of the adult population against COVID-19" , where the revaccination period is 6 months.

The characteristics of all hospitalized patients with COVID-19 were primarily studied in terms of age and gender composition (Table 1). The sample was representative and covered all age groups. To analyze the age and sex composition, all hospitalized patients were divided into groups: 18–25 (2.5%), 25–45 (20.2%), 45–65 (38.2%), 65 years and older (39, 1%). In the age group "65 years and older", a subgroup of patients "80 years and older" was identified, which accounted for 34.9% in this age category.

As can be seen from Table 1, among all hospitalized, the number of women and men was approximately the same, with a slight predominance of men in the age group "18-45 years" and with a significant number of women in the age group "65 years and older", reaching a two-fold excess in the group "80 years and older", which corresponds to the peculiarities of the demographic situation in Russia, in which the average life expectancy of women in recent decades has been significantly higher than that of men. The predominance among hospitalized men aged 25–45 is explained by the fact that at this age the male population is more employed and leads a more active lifestyle (according to the data of the Federal State Statistics Service). At the same time, among men and women, there was a trend towards an increase in the number of hospitalized patients with increasing age, which allows us to conclude that there is an increase in the risk of a severe course of coronavirus infection requiring hospitalization with resuscitation.

Table 1

Age and gender composition of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

Age, years	Number of patients	% of all - hospitalized	Women	Men
Total hospitalized	1981		993	988
18–25	50	2.5%	18	32
25–45	400	20.2%	163	237
45–65	757	38.2%	370	387
65 years and older	774	39.1%	442	332
80 years and older (in the group "65 and older")	270	34.9%	178	92

Over the entire period of the study, the majority of patients were vaccinated with the Gam-COVID-Vak vector vaccine (111 people in total), which amounted to 82.8%. There were 11 patients (6%) vaccinated with the chemically

synthesized Epi-VacCoron vaccine, and 4 patients (2.2%) with the whole-virion inactivated CoviVac vaccine. One patient was revaccinated in accordance with the revaccination period with a one-component Sputnik Light vaccine.

Due to the increase (increase) in the post-vaccination immune layer of the population (according to the Headquarters for measures to prevent the importation and spread of infection caused by the 2019-nCoV coronavirus in Moscow), the number of hospitalizations of vaccinated patients from 5 patients (1.3%) in May 2021 also increased to 41 (14.1%) in October of the same year, which is reflected in Table. 2.

Table 2

The number of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

	May 2021	June 2021	July 2021	August 2021	September 2021	October 2021
Total hospitalized, n	397	428	372	227	267	290
Total vaccinated, n_2	5	38	41	22	34	41
Share of vaccinated, %	1.3	8.9	11.0	9.7	12.7	14.1
Full course V1/V2 + 42 days from V1	1	29	20	15	28	37
Proportion of those vaccinated with a full course of V1/V2 + 42 days from V1, %	0.3	6.8	5.4	6.6	10.5	12.8

In the study group (Table 2) of "total hospitalized" (n), the bulk of patients were admitted via the ambulance which amounted to 1659 people (83.7%), the number of external transfers (from other medical institutions) was 237 people (12.0%), internal transfers (from other departments of the Institute) - 57 patients (2.9%), independently (without medical order) - 28 (1.4%). The structure of hospitalizations of the unvaccinated (n_1) via all sources practically did not differ from the group of all hospitalized (ambulance - 85%, external transfers - 10.2%, transfers within the Institute amounted to 2.6%, self-flow - 1.5% (Table 3). Significant differences were noted in the structure of hospitalizations of the vaccinated. The number of hospitalized via ambulance was significantly less - 64.1%, and the number of external and internal transfers was 2-3 times more (29.3% and 6.1%, respectively), while one person (0.8%) entered independently (Fig. 1, 2).

Table 3

Sources of admissions to infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

	All sources of admission	Ambulance	External transfers	Internal transfers	Without medical order
Total hospitalized, n	1981	1659	237	57	28
Total hospitalized unvaccinated (n_1), n	1800	1543	184	46	27
Total hospitalized vaccinated (n_2), of which:	181	116	53	eleven	1
V1	41	28	53	eleven	0
V2	140	88	42	9	0
Full course V1/V2 + 42 days from V1	130	81	39	9	1

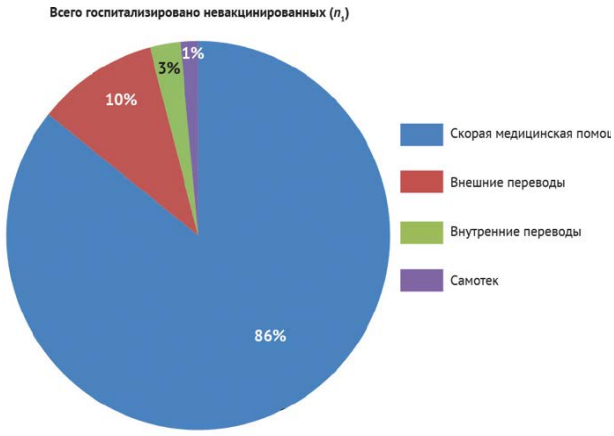

Fig. 1. The distribution of the number of hospitalized by sources of admission in the group of unvaccinated patients

Fig. 2. The distribution of the number of hospitalized by sources of admission in the group of vaccinated patients

Thus, the number of external and internal transfers in the group of hospitalized vaccinated patients requiring resuscitation in a surgical or other profile was higher than in unvaccinated patients. At the same time, it should be taken into account that in patients transferred inside the Institute, COVID-19 was a concomitant disease, which (as a rule) aggravated the course of the underlying (non-infectious) disease, while in those transferred from other medical institutions, coronavirus infection was the main disease and proceeded in severe or extremely severe form or was also a concomitant disease.

Taking into account the fact that the structure of the Institute's bed capacity in the repurposed departments for the treatment of patients with COVID-19 (57% are intensive care beds) is formed to provide assistance to patients in serious condition requiring resuscitation, all patients (by order of the Moscow Health Dpartment) are admitted in a state of or other severity directly to the intensive care unit.

Over the entire period of the study, the majority of patients were admitted in a serious condition (60.5%) and in a state of extreme severity (22.6%) (Table 4). At the same time, unvaccinated patients were admitted mainly in a more severe condition with severe symptoms characteristic of SARS-CoV-2, and the severity at admission in vaccinated patients was determined mainly by a comorbid condition. The severity of changes on CT (computed tomography) of the chest organs (CT-1, CT-2, CT-3, CT-4) was determined taking into account the prevalence and nature of the lesion according to the Interim Guidelines for the Prevention, Diagnosis and Treatment of COVID-19 [16] (Table 5).

Table 4

The condition of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

	Number of patients	State at admission, %		
		Moderate	Severe	Extremely severe
Total hospitalized, n	1981	17	60.5	22.6
Total hospitalized unvaccinated (n_1)	1800	18	58.5	23.6
Total hospitalized vaccinated (n_2), of which:	181	8.3	80.7	11.0
Full course V1/V2 + 42 days from V1	130	6.2	84.6	9.2

Table 5

The volume of lung damage in viral pneumonia COVID-19 (a single standard for the classification of viral pneumonia by severity) of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

CT results	Total hospitalized unvaccinated (n_1), %	Total hospitalized vaccinated (n_2), %	p
CT-0	8.9	16.6	0.042
CT-1	44.4	48.6	0.491
CT-2	19.4	14.4	0.251
CT-3	12.2	9.9	0.602
CT-4	15.0	1.7	0.0001

Note: CT - computed tomography

The data obtained during the treatment of patients with COVID-19 indicate a high incidence of comorbidities. The isolation of comorbid patients (when a patient has several diseases at the same time, one reinforces the other and their negative impact on the body does not add up arithmetically, but geometrically multiplies) into a cohort of both an increased risk of infection with COVID-19 and a severe course of infection due to a mismatch of needs and reserve opportunities organism in the presence of chronic diseases. This also causes a high risk of an unfavorable prognosis for life in this group of patients, while the main causes of mortality are not complications caused directly by infection with the SARS-CoV-2 virus, but complications provoked by an exacerbation of the course of competing (comorbid, chronic) diseases [22–26].

The most significant for the severe course of coronavirus infection are a number of chronic diseases in the patient's history, such as:

— cardiac disorders (leading to the development of acute coronary syndrome, progressive arterial hypertension, decompensation of chronic heart failure, lesions of the conduction system of the heart, acute myocarditis, etc.) [27–29];

– diseases of the gastrointestinal tract (peptic ulcer, gastritis, inflammatory bowel disease, ulcerative colitis, Crohn's disease, etc.), requiring continued anti-relapse therapy using immunosuppressive agents and biological agents (even if the disease is stable), deliberate delay in surgical treatment and endoscopic examinations, which increases the possibility of falling into the following risk groups for developing COVID-19 disease) [30-35];

— diabetes mellitus (hyperglycemia can enhance the processes of replication of respiratory viruses in lung cells, as well as the formation of an imbalance in the hemostasis system, which is manifested by an increase in coagulation activity and a decrease in fibrinolysis, contributing to an increased risk of life-threatening complications) [36–37];

– liver diseases (chronic viral hepatitis, cirrhosis, fatty liver, alcoholic liver diseases), accompanied by moderate hyperenzymemia, hypoproteinemia, etc. [38-42] and kidney diseases, leading to the rapid development and progression of glomerulopathy, tubulopathy, endothelial dysfunctions, thrombosis of the renal arteries different caliber, etc. [43–47];

— cerebrovascular disease (combinations of cerebrovascular pathology and COVID-19 are a risk of developing acute cerebrovascular accident, acute necrotizing encephalopathy and Guillain-Barré syndrome are accompanied by activation of the sympathetic nervous system and acute immunosuppression, which can aggravate the course of COVID-19) [48-52];

— lung diseases (bronchial asthma and chronic obstructive pulmonary disease, which are among the most widespread chronic respiratory diseases and are predictors of severe acute respiratory infection and pneumonia) [53–55];

— other endocrinological diseases (patients with chronic endocrinopathies caused by diseases of the thyroid gland, pituitary gland and adrenal glands, dysfunction of the parathyroid glands, tumors of the endocrine system, etc.) [56–59];

— oncological diseases (patients are more susceptible to infections due to a systemic immunosuppressive state, caused both by the impact of the tumor on the macroorganism itself, and directly by antitumor therapy, which increases the risk of a severe course of the disease and, accordingly, worsens life prognosis) [60–61];

— diseases of the blood system (patients with chronic disorders of hemostasis are more susceptible to the development of disseminated intravascular coagulation syndrome, sepsis-induced coagulopathy, antiphospholipid, hemophagocytic, hypercoagulable syndromes, etc., which determines an unfavorable prognosis for the treatment of patients with COVID-19) [62–66].

Among all hospitalized patients, the group of patients with no history of chronic or concomitant diseases is extremely small and amounted to no more than 2.0%. The main concomitant diseases were various types of chronic diseases: cardiovascular system (67.9%), gastrointestinal tract (22.2%), diabetes (18.0%), liver and kidneys (13.3%), blood vessels brain (13.0%), various (excluding diabetes) diseases of the endocrine system (10.2%), lungs (10.0%), oncological (including those in remission) diseases (7.2%) and diseases blood systems (3.0%) (Table 6). At the same time, the risk ratio progressively increased with an increase in the number of concomitant diseases and reached a maximum in the presence of three or more diseases, while among all those hospitalized with two or more types of concomitant diseases, more than half of those hospitalized suffered.

Table 6

Chronic diseases of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

Accompanying diseases	Unvaccinated, %	Vaccinated, %	R
Cardiac disorders (cardiovascular disease)	67.2	68.5	0.882
Diseases of the gastrointestinal tract	22.8	21.5	0.877
Diabetes	15.6	20.4	0.284
Diseases of the liver and kidneys	16.1	10.5	0.157
Cerebral vascular diseases	11.1	14.9	0.359
Pulmonary diseases	8.3	11.6	0.389
Other endocrinological diseases	10.6	9.9	0.986
Oncological diseases	9.4	5.0	0.150
Diseases of the blood system	5.0	1.1	0.065

Most observations suggest that overweight is one of the most common conditions associated with a severe course of coronavirus disease. According to published data, half of hospitalized patients with COVID-19 are diagnosed with obesity of varying severity, and almost a third of patients are overweight [67-68]. Overweight and obesity are risk factors for invasive mechanical ventilation and death. Obesity is considered as a state of low-level inflammation resulting from an imbalance of adipocytokines (cytokines secreted by adipose tissue) that affect the immune response in COVID-19 [69]. In addition, obesity, due to the restriction of diaphragmatic excursion and reduced chest mobility, leads to an increase in airway resistance, a decrease in respiratory excursion, a decrease in lung volume, and impaired gas exchange, which can provoke congestive pneumonia [70–71]. In most cases, overweight individuals (Table 7) also have other cardiometabolic conditions that increase the risk of infection with SARS-CoV -2, when viruses use adipose tissue as a “reservoir” [72–74]. Obesity also leads to destabilization of the mechanisms of innate immunity, and can also affect the effectiveness of vaccine prophylaxis [75].

Table 7

The distribution of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of NV Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021 according to body mass index

Groups	Body mass index, kg / m ^{2}	Unvaccinated patients	%	Vaccinated Patients	%	Total	%
Underweight	Less than 18.5	5	2.8	2	1.1	7	1.9
Norm	18.5–24.9	52	28.9	44	24.3	96	26.6
Overweight	25–29.9	56	31.1	72	39.8	128	35.5
Obesity 1st degree	30–34.9	41	22.8	41	22.7	82	22.7
Obesity 2nd degree	35–39.9	20	11.1	17	9.4	37	10.2
Obesity 3rd degree	40 and above	6	3.3	5	2.8	11	3.0
Number of patients in the group, n		180		181		361	
Overweight and above	25 and above	123	68.3	135	74.6	258	71.5

As can be seen from Table 7, according to the data of the retrospective analysis, a high frequency of overweight and obesity was revealed in patients who required hospitalization in intensive care units due to the development of COVID-19, and this indicator is higher in the group of vaccinated patients. It should also be noted that the proportion of men with overweight and obesity of 1-3 degrees and above was 57.2%.

The average bed-day during the observation period in the unvaccinated was 10.0, in the group of vaccinated people with a full course of vaccination (V1 + V2) with a period of developing intense (protective) immunity on the 42nd day from the start of vaccination - 8.97 bed-days, and the average resuscitation bed-day was 6.35 and 4.98, respectively (Table 8).

Table 8

The mean duration of stay of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

Indicators	Unvaccinated patients	Vaccinated patients with a full course of V1/V2 + 42 days from V1
Hospitalized	1800	130
Average bed-day	10.00	8.97
Average intensive care bed-day	6.35	4.98

The most obvious are the terms of treatment in intensive care. Within 14 days, 91.5% of all hospitalized patients with intense post-vaccination immunity were discharged from the intensive care unit, while 81.5% of the unvaccinated were discharged. The stay of those who remained on treatment in intensive care units for a period of 15 to 30 days and more than 31 days clearly proves that the need for resuscitation in vaccinated patients is much lower (Table 9).

Table 9

Terms of treatment of hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

Terms of treatment	Unvaccinated patients, %	Vaccinated patients with a full course of V1/V2 + 42 days from V1, %
The length of stay in an intensive care bed is from 1 to 14 days	81.5	91.5
Those who continued to stay in an intensive care bed for 15 to 30 days	15.2	6.9
Those who continued to stay in an intensive care bed for 31 days or more	3.3	1.5

The risk factors for death in patients with COVID-19 also include various comorbidities that are observed in most patients with severe SARS-CoV -2, primarily the cardiovascular system (in general, they were detected in more than 67% of patients), as well as diabetes. diabetes, obesity, diseases of the gastrointestinal tract, lungs, liver and kidneys and other organs and systems. At the same time, the risk ratio for death progressively increased with an increase in the number of comorbidities and age.

During the study period (6 months) in the group of unvaccinated (1,800 patients), 530 people died (mortality rate was 29.4%), with an overall mortality rate of 27.9% among all those hospitalized with a diagnosis of COVID-19. At the same time, out of all those vaccinated who had a full course of vaccination (130 patients), 12 people died, and the mortality rate was 10.8% (Table 10).

Table 10

The number of diseased patients and mortality among hospitalized patients with coronavirus infection caused by the SARS-CoV-2 virus in the infectious departments of resuscitation and intensive care of N.V. Sklifosovsky Research Institute for Emergency Medicine from May 1, 2021 to Nov 11, 2021

Indicators	Total hospitalized patients (n)	Hospitalized unvaccinated patients (n_1)	Vaccinated patients with a full course of V1/V2 + 42 days from V1	R
Hospitalized, n	1981	1800	130	0.0001
Deceased, n	553	530	14	
Lethality, %	27.9	29.4	10.8	

At the same time, only one patient died directly from complications characteristic of the severe course of the coronavirus infection, while in the rest, complications of the severe course of competing diseases were the direct cause of death.

CONCLUSION

The comparison of the course of coronavirus infection, concomitant diseases, the duration and nature of inpatient treatment, the frequency of external and internal transfers between different departments, as well as disease outcomes in vaccinated and unvaccinated patients hospitalized at the Institute revealed that in vaccinated patients with intense post-vaccination immunity, the risk of developing a severe course of coronavirus infection (requiring resuscitation assistance) is much lower. Along with this, the duration of treatment is significantly reduced, especially in intensive care units, and the likelihood of an unfavorable outcome of the disease is reduced to a minimum.

FINDING

1. With coronavirus infection caused by the SARS-CoV-2 virus, the average length of stay in both clinical units and intensive care units in vaccinated patients is significantly less than in unvaccinated patients.

2. Severe or extremely serious condition, present in all patients admitted to the hospital, in the unvaccinated was caused by severe clinical manifestations of coronavirus infection, and in the vaccinated - mostly by comorbid diseases.

3. Mortality among vaccinated patients is significantly lower than among unvaccinated patients, and the immediate cause of death was almost always complications of a severe course of competing (non-infectious) diseases.

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