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Original Article

The Impact of Effective Vaccination on Clinical and Radiological Involvement in COVID-19 Patients

Etkin Aşılamanın COVİD-19 Pnömonisinde Klinik ve Radyolojik Tutulum Üzerindeki Etkisi

Coskun DOGAN[1], Deniz BILICI[1], Burcu ARPINAR YIGITBAS[1], Omer ZENGIN[1], Orhan ZOR[2], Oguzhan AKMAN[1], Ilyas KOCABAG[1], Gonul Seven YALCIN[1], Esra ERTAN YAZAR[1]

[1]Istanbul Medeniyet University Faculty of Medicine, Department of Chest Diseases, Istanbul, Turkey
[2]Istanbul Medeniyet University Faculty of Medicine, Department of Family Medicine, Istanbul, Turkey

ABSTRACT

Objective: We aimed to analyze clinical, radiological, and laboratory differences between vaccinated and unvaccinated patients admitted to hospital due to coronavirus disease-2019 (COVID-19) pneumonia.

Methods: Patients hospitalized in the COVID-19 clinic between February 2022 and August 2022 were included in the study. Demographic, clinical features, and treatment results. Furthermore, the COVID-19 vaccination status of the cases was recorded. The cases were divided into two groups as those with and without COVID vaccination and compared.

Results: A total of 215 patients were included in our study, and the patients were divided into 2 groups according to their vaccination status: those who were unvaccinated against COVID-19 (n=100) and those who vaccinated COVID-19 (n=115). The presence of comorbid chronic diseases and cancer was lower in the unvaccinated group. The duration of hospitalization was longer in the unvaccinated group than in the vaccinated group (9.6 and 7.1 days, respectively) (p<0.001). While there was no difference between the two groups in terms of the radiological involvement pattern, the number of involved segments was significantly higher in the unvaccinated group (p<0.05). The number of patients who received high-dose glucocorticoid therapy in the unvaccinated group was higher (28 cases vs. 11 cases; p<0.001). There was no statistically significant difference between the two groups in terms of transfer of patients to the intensive care unit (p>0.05). 11.3% (13/115) of the patients in the vaccinated group died, whereas 14% (14/100) died in the unvaccinated group.

Conclusions: The vaccinated cases who were infected with COVID-19 had a shorter duration of hospitalization and lower severity of radiological involvement. The requirement for pulse steroids was also less compared with unvaccinated individuals. Despite having chronic diseases and cancer, which is considered to have a significant effect on mortality in COVID-19 patients. In addition, although the vaccinated group was older, they had mortality rates similar to those of unvaccinated subjects.

Keywords: COVID-19, COVID-19 related mortality, vaccination

ÖZ

Amaç: Bu çalışmada aşı yapılmış koronavirüs hastalığı-2019 (COVİD-19) pnömonileri ve aşı yapılmamış COVİD-19 pnömonileri arasındaki klinik-radyolojik ve laboratuvar farklılıkları araştırılmıştır.

Yöntemler: Çalışmaya Şubat 2022-Ağustos 2022 tarihleri arasında COVİD-19 kliniğinde yatan olgular dahil edildi. Olguların klinik-radyolojik özellikleri, laboratuvar tetkikleri, tedavi öyküleri, klinikte takip süreleri, tedavi sonuçları ve COVİD-19 aşı durumları kayıt edildi. Olgular COVİD-19 aşısı olan ve olmayanlar olarak iki gruba ayrıldı. Her iki grubun klinik, radyolojik ve laboratuvar özellikleri karşılaştırıldı.

Bulgular: Çalışmamıza toplam 215 hasta dahil edilmiş olup, hastalar aşılanma durumlarına göre COVİD-19 aşısı olmayanlar (n=100) ve COVİD-19 aşısı olanlar olmak üzere 2 gruba ayrıldı (n=115). Aşı olmayan grupta eşlik eden ek kronik hastalıklar ve kanser varlığı daha azdı. Aşı olmayan grubun aşı olan gruba göre yatış süresi daha fazlaydı (sırasıyla 9,6 ve 7,1 gün) (p<0,001). Radyolojik tutulum paterni açısından her iki grup arasında fark saptanmaz iken, aşı olmamış grupta tutulan segment sayısı istatistiksel anlamlı olarak daha yüksekti (p<0,05). Aşı olmayan grupta yüksek dozda glukokortikoid tedavisi verilen olgu daha fazlaydı (28 olguya karşı 11 olgu; p<0,001). Hastaların yoğun bakım ünitesine transferi açısından iki grup arasında istatistiksel anlamlı fark yoktu (p>0,05). Aşılı grupta olguların %11,3'ü (13/115) eksitus olur iken, aşısız grupta %14'ü (14/100) eksitus olmuştu (p=0,855).

Sonuçlar: COVİD-19 aşısı olan olguların aşı olmayanlara göre hastaneden daha kısa sürede taburcu olmaktadır, radyolojik olarak tutulum oranları daha düşüktür ve daha az yoğun tedaviye (puls steroid) maruz kalmaktadırlar. Aşı olmayan olgular daha genç yaşta, kanser de dahil daha az ek hastalığa sahip olmalarına rağmen aşı olmuş olgular ile benzer mortalite özelliği göstermektedirler.

Anahtar kelimeler: COVİD-19, COVİD-19 ilişkili mortalite, aşılama

Address for Correspondence: C. Dogan, Istanbul Medeniyet University Faculty of Medicine, Department of Chest Diseases, Istanbul, Turkey
E-mail: coskund24@hotmail.com **ORCID ID:** orcid.org/0000-0002-6948-5187

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INTRODUCTION

Coronavirus disease-2019 (COVID-19), which emerged in Wuhan, China, in 2019, has been one of the deadliest pandemics in recent history. There is a wide variation in clinical findings among patients with COVID-19, and mortality is broadly based on respiratory insufficiency. Mortality ranges from 2 to 5% in the general population; nevertheless, these rates can differ in immune suppressive, chronic cardiovascular, and pulmonary diseases[1-3]. At the time of this article, 759,408,703 people were infected all over the world, and 6,866,434 people died from this disease[4,5].

Vaccination is an effective and economical way to combat infectious diseases. While there was only symptomatic treatment against COVID-19 disease at the beginning of the pandemic, vaccine studies started in March 2020, immediately after the outbreak of the pandemic. Today, it is thought that a more effective fight against the disease is made with more than one COVID-19 vaccine, whose phase 2 and phase 3 studies have been completed urgently[6].

In pandemic periods, especially in rapidly spreading diseases such as COVID-19, the development of effective and safe vaccines requires comprehensive testing, and mass production is a difficult process. This has been achieved via today's cutting-edge technology, but the effects and side effects of vaccines should be followed-up closely[7].

Until now, studies on vaccination in COVID-19 patients have mostly focused on reducing symptomatic infections and hospitalizations[8,9].

In this study, the clinical and radiological features of patients with and without COVID-19 vaccine inoculations were compared, and the clinical radiological effectiveness of the vaccine was investigated.

MATERIALS and METHODS

Reverse transcription polymerase chain reaction (RT-PCR)-positive cases who were hospitalized in the COVID chest diseases clinic of our institution between February 2022 and August 2022 were included in this retrospective analysis. The research was planned in accordance with the International Declaration of Helsinki and approved by the Clinical Research Ethics Committee of Istanbul Medeniyet University Goztepe Training and Research Hospital (decision no: 2021/0728, date: 12.01.2022).

Demographic information of the patients, such as age, gender, smoking history, and additional chronic diseases, was recorded. Routine radiological and laboratory tests, clinical characteristics of the cases, treatment histories, COVID vaccine status, follow-up periods, and treatment results were recorded for all hospitalized patients diagnosed with COVID-19 pneumonia. Individuals were divided into two groups: those with and without effective COVID vaccination. The clinical, radiological, and laboratory features of both groups were compared.

Cases <18 years old, with RT-PCR test, unknown COVID-19 vaccination, who were not vaccinated effectively, and pregnant women were not included in the study.

COVID-19 Pneumonia Case Definition and Treatment

All of the study population consisted of individuals that were found to be positive in real-time RT-PCR with a combined swab sample (oropharyngeal and nasal swab) according to the COVID-19 diagnosis and treatment guidelines of the Ministry of Health. Bilateral diffuse (>50%) lung involvement and/or respiratory rate ≥24/minute, and/or room air SpO_2 level ≤93% has been observed in hospitalized patients.

The treatment of the cases was regulated according to the COVID-19 diagnosis and treatment guideline of the Ministry of Health of Turkey, and if there were no contraindications, low-molecular-weight heparin was used for thrombosis prophylaxis, favipiravir was used as antiviral treatment, oxygen support in cases who have passed the viral replication phase (first 5-7 days), 6 mg/day dexamethasone or 0.5-1 mg/kg prednisolone was administered. Additionally, in cases with clinical and radiological worsening with increased oxygen demand in 24 h despite treatment and increased acute phase response, a higher dose of glucocorticoid (pulse ≥250 mg/day methyl prednisolone) has been administered[10].

Radiological Evaluation of COVID-19 Pneumonia

Non-contrast chest tomography was performed for each patient as a standard radiological evaluation. Thorax computed tomography (CT) was performed using a 16-slice CT scanner (GE Optima CT520) with the following acquisition parameters: tube voltage 100 kV, tube current 70-120 mAs, slice thickness 1.25 mm, automatic dose modulation, CT volumedose index 5.60 mGy, dose length product 179.32-210.48 mGy, and effective dose 2.5-2.9 mSv. In the evaluation of thoracic CTs, the involvement patterns of the lesions (ground glass opacities, consolidation, air bronchogram, interlobular septal thickening, etc.) were examined and recorded. In addition, considering the total number of segments out

of 17, the number of segments involved with the lesion in each COVID-19 case was recorded[11].

Vaccination Status

Patients who were inoculated with two types of vaccine, which were routinely used in our country at the time of the study, were included in the study. Individuals were considered to be fully vaccinated if they received inactivated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine produced by Sinovac as 2 doses (0.5 mL) intramuscularly and had the last dose at least 14 days ago or inoculated by 2 doses (0.3 mL) intramuscularly Pfizer/Biontech vaccine, last dose at least 21 days ago, and did not exceed 6 months after the last dose of vaccine[12].

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 software. Central tendency measures (mean and standard deviation) for numerical variables and calculated frequency distributions (number and percentage) for categorical variables are described in the study data. The presence of differences between the two groups using an independent sample t-test was evaluated under appropriate conditions. The chi-squared test for assessing associations between categorical variables was used.

RESULTS

The files of 273 patients hospitalized in the COVID clinic between February 2022 and August 2022 were enrolled in this retrospective analysis. Thirty-one cases were excluded because their vaccination status was unknown, and 27 cases were excluded because their PCR test was negative. A total of 215 patients were included in our study, and the patients were divided into 2 groups according to their vaccination status: those without an effective COVID-19 vaccination (n=100) and those who had an effective COVID-19 vaccination (n=115). Of the COVID effective vaccination group, 67 (58.2%) were inoculated with inactivated vaccines and 48 (41.8%) with RNA-based vaccines.

The mean age of the unvaccinated group was 57.66±17.05 years, and that of the vaccinated group was 72.27±14.08 (p<0.001). There was no difference between the two groups in terms of gender. Comorbid diseases and cancer were more common in the vaccinated group. The duration of hospitalization in the unvaccinated group was 9.60±6.0 days, whereas the hospitalization period in the vaccinated group was significantly shorter, 7.19±3.77 days (p<0.001), (Table 1).

When the laboratory parameters of the patients were examined, statistically significant differences were observed between total leukocyte count [white blood cell (WBC)], hemoglobin, hematocrit, lymphocyte percentage, neutrophil count and percentage, and eosinophil count and percentage between unvaccinated and vaccinated patients (Table 2).

When biochemical parameters were examined, urea and creatinine values were statistically higher in vaccinated patients (unvaccinated and vaccinated, respectively, urea: 31.68±15.28, 46.90±29.92; creatinine: 0.858±0.252, 1.02±0.396). Serum C-reactive protein (CRP) and procalcitonin (PRC) levels of the vaccinated patients were significantly higher (Table 2).

Although there was no difference between the two groups in terms of the involvement pattern in the radiological evaluations of the patients, the number of segments involved in the vaccinated group was significantly lower (Table 3).

Table 1. Baseline demographics of the patients.

Variable	Unvaccinated (n=100)	Vaccinated (n=115)	p-value
Age (median ± SD)	57.66±17.05	72.27±14.08	**<0.001**
Gender (n/%)			
Female	50 (50)	56 (48.6)	0.849
Male	50 (50)	59 (51.4)	
Comorbid disease (n/%)			
Endocrine disorders			
No	99 (99)	111 (96.5)	0.229
Yes	1 (1)	4 (3.5)	
Chronic cardiac diseases			
No	93 (93)	90 (82.6)	**0.002**
Yes	7 (7)	25 (17.3)	
Chronic neurologic disease			
No	91 (91)	88 (76.5)	**0.005**
Yes	9 (9)	27 (23.5)	
Chronic respiratory disease			
No	93 (93)	94 (81.7)	**0.014**
Yes	7 (7)	21 (18.3)	
Cancer			
No	99 (99)	104 (90.4)	**0.006**
Yes	1 (1)	11 (9.6)	
Hospitalization time/day (mean ± SD)	9.60±6.0	7.19±3.77	**<0.001**

DM: Diabetes mellitus, SD: Standard deviation

While no difference was observed between the antiviral treatments administered to both groups, individuals who were administered high-dose glucocorticoid (pulse steroid) treatment were higher in the unvaccinated group (28 cases vs. 11 cases; p<0.001). The total number of steroid used days was also significantly higher in unvaccinated cases (8.69±5.26, 6.54±3.72, respectively; p<0.001) (Table 4).

There was no statistically significant difference between the two groups in terms of intensive care unit (ICU) admissions (15.6%, n=18/115 of the cases in the vaccinated group and 18%, n=18/100) in the unvaccinated group were transferred to the ICU, (p=0.703). In terms of mortality, 11.3% (13/115) of the cases died in the vaccinated group and 14% (14/100) in the unvaccinated group. No statistically significant difference between the two groups was achieved (p=0.855).

DISCUSSION

In this study, we investigated the importance of effective vaccination in COVID-19 disease, whether cases with COVID-19 vaccine were hospitalized for a shorter period, the rate of radiological involvement was lower, and they had less requirement for high-dose/pulse steroid treatment that had to be used in severe patients. In addition, we have attempted to observe the difference in immunological response (higher CRP, PRC, WBC, and lower lymphocyte percentage) in COVID-19 pneumonia. It has been observed that both groups had similar mortality rates despite older age and the presence of additional chronic diseases, including cancer, in the vaccinated group.

As in other diseases involving the lung parenchyma, thoracic CT has an important diagnostic role in COVID-19 pneumonia, classification of its severity, and monitoring of the response to treatment[13]. Li et al.[14] investigated 98 cases who died due to COVID-19 (46 cases) and

Table 2. Laboratory parameters of the patients.

Variable (mean ± SD)	Unvaccinated (n=100)	Vaccinated (n=115)	p-value
WBC (uL)	6.40±2.90	9.37±4.76	**<0.001**
Hb (g/dL)	13.29±1.54	12.65±1.67	**0.004**
Htc (%)	39.69±4.17	38.40±4.84	**0.040**
Platelets (uL)	175.26±72.80	215.07±94.98	**<0.001**
Lymphocytes (uL)	1.12±1.40	1.19±0.86	0.639
Lymphocytes %	18.21±11.22	14.82±10.06	**0.021**
Neutrophils (uL)	5.03±2.86	7.68±4.41	**<0.01**
Neutrophils %	75.05±14.13	78.94±11.56	**0.028**
Eosinophils (uL)	0.015±0.046	0.044±0.123	**0.018**
Eosinophils %	0.228±0.612	0.423±0.831	**0.051**
CRP (mg/L)	72.23±60.65	113.05±77.46	**<0.001**
PCT (mg/L)	0.92±5.92	2.27±14.20	**0.010**
Glucose (mg/dL)	144.63±83.20	152.86±74.37	0.451
Urea (mg/dL)	31.68±15.28	46.90±29.92	**<0.001**
Creatinine (mg/dL)	0.858±0.252	1.02±0.396	**<0.001**
AST (U/L)	55.32±50.79	44.10±48.37	0.069
ALT (U/L)	41.71±49.13	30.71±29.96	0.054
GGT (U/L)	51.83±75.45	44.73±48.37	0.096
LDH (U/L)	426.70±165.77	385.62±167.48	0.681
Total protein (g/L)	65.41±4.89	65.72±5.89	0.678
Albumin (g/L)	38.14±3.97	37.07±3.71	**0.042**
Na (mmol/L)	135.51±3.59	135.45±5.62	0.924
K (mmol/L)	4.08±0.43	4.17±0.45	0.170
Cl (mmol/L)	98.29±4.02	106.01±84.57	0.368

AST: Aspartate transaminase, ALT: Alanine transaminase, CRP: Serum C-Reactive protein, Cl: Chloride, GGT: Gamma-glutamyl transpeptidase, Hb: Hemoglobin, Htc: Hematocrit, K: Potassium, LDH: Lactate dehydrogenase, Na: Sodium, Avg: mean, PCT: Procalcitonin, SD: Standard deviation

Table 3. Radiologic properties of patients.			
Variable	**Unvaccinated (n=98)**	**Vaccinated (n= 112)**	**p-value**
Thorax CT findings			
Ground glass opacities (n/%)			
No	13 (13.2)	21 (18.7)	0.282
Yes	85 (86.8)	91 (81.8)	
Consolidation (n/%)			
No	50 (51)	62 (55.3)	0.530
Yes	48 (49)	50 (44.7)	
Air bronchogram (n/%)			
No	57 (58.1)	75 (66.9)	0.188
Yes	41 (41.9)	37 (33.1)	
Cobblestone view (n/%)			
No	88 (89.7)	99 (88.3)	0.745
Yes	10 (10.3)	13 (11.7)	
Halo/reverse halo skin (n/%)			
No	88 (89.7)	106 (94.6)	0.187
Yes	10 (10.3)	6 (5.5)	
Interlobular septal thickening (n/%)			
No	86 (87.7)	90 (80.3)	0.147
Yes	12 (12.3)	22 (19.7)	
Mediastinal LAM (n/%)			
No	59 (60.2)	69 (61.6)	0.835
Yes	39 (39.8)	43 (38.3)	
Pleural effusion (n/%)			
No	92 (93.8)	103 (91.9)	0.591
Yes	6 (6.2)	9 (8.1)	
Number of segments retained in Thorax CT (n/%)	12.81±3.58	11.22±4.69	**0.006**
CT: Computed tomography, LAM: Lymphadenomegaly			

Table 4. Treatments of study groups.			
Variable	**Unvaccinated (n=100)**	**Vaccinated (n=115)**	**p-value**
Treatment			
Favipiravir treatment (n/%)			
No	40 (40)	61 (53)	0.075
Yes	58 (58)	54 (47)	
Pulse steroid treatment (n/%)			
No	72 (72)	104 (90.4)	**<0.001**
Yes	28 (28)	11 (9.6)	
Total number of steroid days used (mean ± SD)	8.69±5.26	6.54±3.72	**<0.001**
SD: Standard deviation			

survived after COVID-19 (52 cases) and stated that lung involvement was 53.2% in the thorax CT of the deceased group and this rate was 35% in survived cases (p<0.001). In our study, radiological involvement patterns (ground glass, consolidation, interlobular septal thickening, air bronchogram) were similar between the vaccinated and unvaccinated groups (p>0.05). On the other hand, there was significantly less segment involvement in the vaccinated group (p=0.006). This finding suggests that effective vaccination may limit the radiological course of the disease. Lee et al.[15] evaluated the characteristics of vaccinated and unvaccinated patients (total n=761) and reported that 41% of vaccinated cases and 78% of unvaccinated cases had pneumonia (p<0.001). The results of this study also emphasized that vaccination in COVID-19 patients may be associated with radiological severity, similar to our study.

In COVID-19 pneumonia, radiological methods can be used to show the severity of the disease, and cheaper reproducible laboratory methods without harmful radiation effect[16]. One of them is peripheral blood lymphocytes. Many studies have shown that lymphopenia is mostly seen in COVID-19 cases, and this is associated with the severity of the disease. Lymphopenia has been detected in most of these studies, and this has been attributed to the hypothesis that the virus directly infects lymphocytes or affects lymphatic organs, inhibits lymphocytes by secreted inflammatory cytokines, or decreases the number of lymphocytes in the peripheral blood because of migration to inflammatory regions[16-19].

There are few studies on the effect of the COVID-19 vaccine on hematological parameters. Among them, Sing et al.[20] found that the risk of leukopenia-neutropenia increased especially after mRNA vaccines in cases >60 years old, but they could not come to a conclusion about the exact reason for this[21]. The lymphocyte counts of the cases included in this study were not evaluated. On the other hand, Mulligan et al.[22] identified lymphopenia in post-vaccination cases. The authors concluded that this finding was because RNA vaccines induce type 1 interferon, which is associated with transient migration of lymphocytes into tissues and does not affect the clinical situation. Our study is compatible with the literature in this respect. The lymphocyte percentage value was lower in the COVID-19 vaccinated group than in the unvaccinated group (14.8±10, 18.2±11.2, p=0.021, respectively). Natural COVID-19 infection causes lymphopenia, and proinflammatory cytokine release and acute phase reactants are increased in severe COVID-19 infection[23,24]. Although the reaction of the immune

system against COVID-19 has not yet been solved, lymphocytes have great importance in both innate and vaccine-induced immunity (CD8-CD4 lymphocytes)[25-27]. Similar to other coronaviruses, a lymphocyte-mediated (t-lymphocyte) protective immune response is induced in SARS-CoV-2 infections. We interpreted that the lymphocyte percentage values of the vaccinated cases were lower at the beginning of the disease compared with those of the unvaccinated cases, as the human immune system that encounters COVID-19 through vaccination has a preparation against COVID-19 from the beginning of the disease. In our study, acute phase reactants, such as CRP and PRC, and WBC and neutrophil counts were also found to be higher in vaccinated COVID-19 cases than in vaccinated COVID-19 cases. Similarly, the higher CRP, PRC, and WBC values of vaccinated cases suggested that vaccinated individuals may have a different immune response to COVID-19 disease. Although we cannot prove this hypothesis at the moment, prospective studies are planned to investigate the clinical features of vaccinated and unvaccinated cases in the future. CRP, PRC, WBC, and lymphopenia levels were determined by evaluating the antibody level against COVID-19 in vaccinated cases with high acute phase reactant levels and low lymphopenia. Our hypothesis can be proved or disproved by examining the antibody level correlation.

Although the cause has not been fully elucidated, life-threatening pneumonia, respiratory failure, and acute respiratory distress syndrome (ARDS) develop in some cases of COVID-19. Studies have shown that such patients have higher serum cytokine levels, which is called cytokine storm[28,29]. There are conflicting results regarding the use of corticosteroids in COVID-19 pneumonia. Bartoletti et al.[30] reported that there was no effect on mortality in patients treated with corticosteroids in hospitalized cases, and the effect of corticosteroid treatment on mortality may be limited to COVID-19 patients with critical illness. On the other hand, Edalatifard et al.[31] reported that mortality was lower and recovery time was shorter in the group who received 250 mg/day intravenous methylprednisolone for 3 days in a single-blind, randomized controlled study. While there was no difference between the two groups of antiviral and routine glucocorticoid (0.5-1 mg/kg prednisolone) treatments in our study, the cases in which we had to switch to pulse steroid treatment because of clinical radiological deterioration and increased oxygen demand under routine treatment were more common in the unvaccinated group. Pulse steroid was initiated in 28 cases in the unvaccinated group, and 11 cases in the vaccinated group ($p<0.001$). In addition, we used glucocorticoids for a total of 8.69±5.26 days in the unvaccinated group, whereas we used glucocorticoids for 6.54±3.72 days in the vaccinated group ($p<0.001$).

Today, vaccination against COVID-19 significantly reduces hospitalizations and is highly protective against severe illness and death, especially in adults older than 65 years[32]. Despite this, vaccine hesitancy and society's perspective on vaccination may differ, especially during times of pandemic[33]. The Centers for Disease Control and Prevention pays particular attention to the protection/vaccination of people at high risk for severe disease[34]. Tenforde et al.[35] compared the characteristics of hospitalized vaccinated and unvaccinated COVID-19 cases, as in our study[31]. In their study, the unvaccinated (n=314) COVID-19 cases consisted of a younger population than the vaccinated group (n=1669) (53-67, respectively). Similarly, chronic diseases were less frequent in the unvaccinated group. The authors concluded that vaccination against COVID-19 may prevent the progression to invasive mechanical ventilation and death. In our study, the data of both groups were similar in terms of death and ICU course. This may be because our study was planned with a relatively small sample size. However, the fact that the vaccinated group consisted of patients with advanced age and additional disease, that is, at high risk in terms of severe disease, had a relatively low risk and similar mortality compared with the younger age group, which may be related to being vaccinated.

One of the main limitations of our study could be attributable to its retrospective nature and relatively small sample size in a single center. Not knowing the blood antibody levels of the vaccinated cases, not knowing the blood antibody levels, which is one of the real indicators of immunity against COVID-19, and not knowing whether there is a correlation between antibody levels and parameters such as radiological involvement frequency and laboratory values are other limitations of our study. In addition, the inability to conduct examinations according to vaccine subgroups can be counted among the limitations. Another limitation of this study is the age difference between the groups. Due to the prioritized vaccination of the elderly in Turkey, our study population has emerged in this direction. These limitations should not be ignored when interpreting the results of this study.

CONCLUSION

The vaccinated cases who were infected with COVID-19 had a shorter duration of hospitalization and lower intensity of radiological involvement. The requirement for pulse steroids was also less compared with unvaccinated individuals. Despite having chronic

diseases and cancer, which is considered to have a significant effect on mortality in COVID-19 patients. In addition, although the vaccinated group was older, they had mortality rates similar to those of unvaccinated subjects.

Ethics

Ethics Committee Approval: The research was planned in accordance with the International Declaration of Helsinki and approved by the Clinical Research Ethics Committee of Istanbul Medeniyet University Goztepe Training and Research Hospital (decision no: 2021/0728, date: 12.01.2022).

Informed Consent: Retrospective study.

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Author Contributions

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