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Neuropathic Pain After COVID-19 Infection

COVID-19 Enfeksiyonu Sonrası Nöropatik Ağrı

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ABSTRACT Objective: Pain often accompanies respiratory symptoms in coronavirus disease-2019 (COVID-19) during all stages of the disease). The present study aimed to investigate the presence of neuropathic pain and other clinical symptoms in patients with COVID-19. **Material and Methods:** A total of 250 patients who had recovered from COVID-19 and presented with the pain symptom after the disease were included in the study. The patients were classified into the following two groups: Group 1 with subacute-prolonged COVID-19 (clinical presentation for 4-12 weeks after onset of acute disease) and Group 2 with chronic-post COVID-19 syndrome (clinical presentation lasting for >12 weeks after onset of acute disease and could not be explained by any of the alternative diagnoses). PainDETECT Questionnaire, visual analog scale, and depression anxiety scale were used for the evaluations. **Results:** The patients included in the study comprised 143 (57.2%) females and 107 (42.8%) males. Among all patients, 130 patients were classified into Group 1 (52%) while 120 patients were classified into Group 2 (48%). Neuropathic pain was experienced by 32 (12.8%) patients, and 68.8% (n=22) of the patients with neuropathic pain were classified into Group 2. Neuropathic pain was 0.371 times lower in Group 1 patients (p: 0.014), while it was 4.28 times higher in patients who had been hospitalized (p<0.001), 16.53 times higher in patients who had been admitted to the intensive care unit (p<0.001), and 5.23 times higher in patients who had experienced pulmonary involvement (p<0.001). **Conclusion:** After patients recover from COVID-19, they should be carefully evaluated for the presence of neuropathic pain and provided pain management, particularly those who were hospitalized, admitted to the intensive care unit, and had experienced pulmonary involvement during the disease.

Keywords: Coronavirus disease 2019; chronic COVID-19; neuropathic pain; subacute-prolonged COVID-19

ÖZET Amaç: Koronavirüs hastalığı-2019 [coronavirus disease-2019 (COVID-19)] enfeksiyonunda ağrı sıklıkla solunumsal semptomlara hastalığın her sürecinde eşlik etmektedir. Biz de çalışmamızda, geçirilmiş COVID-19 enfeksiyonu sonrası nöropatik ağrı sıklığını araştırmayı hedefledik. **Gereç ve Yöntemler:** Çalışmaya ağrı şikâyeti ile başvuran hastalardan COVID-19 geçiren 250 hasta dâhil edildi. Hastalar subakut-uzamış COVID-19 (akut hastalık başlangıcından sonraki 4-12. haftalar arasındaki klinik tablo) Grup 1 ve kronik post-COVID-19 sendromu (akut hastalık başlangıcından sonraki 12. haftadan uzun süren ve alternatif tanılarla açıklanamayan klinik tablo) Grup 2 olarak incelenmiştir. Hastaların görsel analog skala, depresyon anksiyete skalası, Pain detect nöropatik ağrı anketi de değerlendirildi. **Bulgular:** 143 (%57,2) kadın, 107 (%42,8) erkek hastanın katıldığı çalışmamızda, Grup 1 hasta sayımız 130 (%52), Grup 2 hasta sayımız ise 120 (%48) idi. Nöropatik ağrısı olan hasta sayımız 32 (%12,8) idi. Nöropatik ağrısı olan hastalarımızın %68,8'i (n=22) Grup 2'de idi. Nöropatik ağrı durumuna etki eden risk faktörlerinin incelenmesi ile Grup 1'de nöropatik ağrı riski 0,371 kat daha az iken (p: 0,014), hastane yatışı olanlarda 4,28 (p<0,001), yoğun bakım ihtiyacı olanlarda 16,53 (p<0,001), pulmoner tutulumu olanlarda 5,23 kat (p<0,001) nöropatik ağrı riskinde artış saptanmıştır. **Sonuç:** Geçirilmiş COVID-19 enfeksiyonu sonrası ağrı yönetiminde nöropatik ağrının varlığı, özellikle hastane yatışı, yoğun bakım ihtiyacı ve pulmoner tutulumu olanlarda dikkatle irdelenmelidir.

Anahtar Kelimeler: Koronavirüs hastalığı-2019; kronik COVID-19; nöropatik ağrı; subakut-uzamış COVID-19

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Coronavirus disease-2019 (COVID-19) was first reported in the city of Wuhan, China, in December 2019, following which it spread rapidly to all nations across the world, including Türkiye.[1-3]

COVID-19 is a viral disease caused by the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), which primarily affects the respiratory system, although could also affect other organ systems. Neurological complications may arise during or after the onset of this disease and are reportedly associated with the direct invasion of the nervous system, various autoimmune mechanisms, and systemic and metabolic disorders due to the associated critical diseases.[4] One of the complications of COVID-19, musculoskeletal involvement commonly presents with arthralgia, myalgia, and proximal muscle weakness and is characterized by elevated levels of creatine kinase. As the number of patients and survivors of COVID-19 increases globally, an increasing number of studies are reporting musculoskeletal, neuromuscular, and rheumatological complications in COVID-19 patients and the association of these complications with treatment course and hospital stay.[5,6]

Neuropathic pain is a severe and complex pain syndrome occurs due to peripheral and central lesions in the neuronal pain pathway and is usually unresponsive to analgesics.[1] Neuropathic pain is heterogeneous in nature, with no single etiology or pathological mechanism.[7,8] To date, neuropathic pain has been reported in 2.3% of patients with COVID-19 although its prevalence is speculated to be much higher as this pain and the associated damage to the nervous system could develop and be detected several months after recovery from the disease.[9,10]

The present study aimed to investigate the clinical symptoms of patients who had recovered from COVID-19 and then presented to the physical therapy and neurology outpatient clinics to explore the cases of neuropathic pain in COVID-19.

MATERIAL AND METHODS

A total of 250 patients who had recovered from COVID-19 and later presented to the Physical Therapy and Neurology Outpatient Clinic of the Elazığ Fethi Sekin City Hospital were included in the present study. The study was conducted in accordance with the principles of the Declaration of Helsinki (2008). The study procedure was approved by the Non-invasive Research Ethics Committee of Fırat University, Elazığ, Türkiye (date: November 25, 2021, no: E-97132852-100-113095) and the Ministry of Health, Türkiye. Each patient signed an informed consent form for participation in the study. The minimum number of patients to be included in the study was determined to be 250 to achieve 80% power at the significance level of α=0.5 with a medium effect size.

Patients with symptoms such as unexplained joint pain, myalgia, weakness, fatigue, headache, and paresthesia were accepted for inclusion in the study. The date when the patients received a positive polymerase chain reaction (PCR) test result and the dates of hospitalization and admission to the intensive care unit (ICU) were recorded. Pain was measured using the visual analog scale (VAS), and the patients were inquired regarding the associated symptoms, pulmonary involvement, previous hospitalization, and ICU admission. The depression anxiety scale and the painDETECT questionnaire (PD-Q) were completed by all included patients. Next, for the analysis, all patients were classified into two groups based on the time elapsed from the positive PCR test result: Group 1 comprised patients with subacute-prolonged COVID-19 (clinical presentation for 4-12 weeks after the onset of acute disease) and Group 2 comprised patients with chronic post-COVID-19 syndrome (clinical presentation lasting for >12 weeks after the onset of acute disease and could not be explained by any of the other diagnoses). Patients with signs and symptoms that could be explained by any other diagnosis, had undergone surgery recently, had a malignancy, were subjected to chemotherapy or radiotherapy, or had a history of any rheumatic-autoimmune disease were excluded from the study.

A score of ≥19 on PD-Q was considered significant for the presence of neuropathic pain. The study data were analyzed using the IBM SPSS v23 (Chicago, USA) software. The hypothesis of normal distribution was tested using the Shapiro-Wilk test. Next, the Mann-Whitney U test was conducted to compare the data without normal distribution in

paired groups. Statistics from the Yates correction, Pearson's chi-squared test, and Fisher's exact test were conducted to determine and analyze the correlations between the categorical variables in the two groups. The independent risk factors affecting central sensitization and neuropathic pain conditions were determined using binary logistic regression analysis, and the results were presented as mean±standard deviation and median (minimum-maximum) for the quantitative data and frequency (percentage) for the categorical variables. p values of <0.05 indicated statistical significance.

RESULTS

Among the patients included in the present study, 57.2% (n=143) were females and 42.8% (n=107) were males. In the classification of the included patients based on the time elapsed from the positive PCR test result, 52% (n=130) of patients formed Group 1 (patients with subacute-prolonged COVID-19), while 48% (n=120) of patients formed Group 2 (patients with chronic post-COVID-19 syndrome). In addition, 17.2% (n=43) of the included patients required hospitalization and 3.6% (n=9) of the patients had to be admitted to the ICU. Pulmonary involvement was detected in 24.4% (n=61) of the included patients. Fatigue was the most common symptom (74.4% of all included patients, n=186), followed by myalgia (58%, n=145), palpitations (55.6%, n=139), and joint pain (48.8%, n=122), respectively. Overall, 12.8% (n=32) of the included patients experienced neuropathic pain. Table 1 lists all patient characteristics and symptoms.

Further, the symptoms after recovery from COVID-19 were compared between the patients of the two groups. Hospitalization (p=0.021), pulmonary involvement (p=0.023), neuropathic pain (p=0.020), chest pain (p<0.001), joint pain (p=0.008), weakness (p=0.001), and dyspnea (p=0.047) were revealed to be significantly different in Group 2 compared to Group 1. Admission to intensive care, fatigue, myalgia, headache, gastrointestinal symptoms, and palpitations were the symptoms that did not differ between the two groups. Diabetes mellitus, hypertension, coronary artery disease, and thyroid disease were detected in 19.7% (n=25) of the patients

TABLE 1: Frequency and percentage values for the categorical variables.

	Frequency (n)	Percentage (%)
Gender		
Female	143	57.2
Male	107	42.8
Groups		
4-12 weeks after the onset of acute disease (Group 1)	130	52.0
>12 weeks after the onset of acute disease (Group 2)	120	48.0
Hospitalization		
Yes	43	17.2
No	207	82.8
Intensive care		
Yes	9	3.6
No	241	96.4
Pulmonary involvement		
Yes	61	24.4
No	189	75.6
Neuropathic pain		
Yes	32	12.8
No	218	87.2
Fatigue		
Yes	186	74.4
No	64	25.6
Chest pain		
Yes	79	31.6
No	171	68.4
Joint pain		
Yes	122	48.8
No	128	51.2
Myalgia		
Yes	145	58.0
No	105	42.0
Headache		
Yes	64	25.6
No	186	74.4
Dyspnea		
Yes	41	16.4
No	209	83.6
Gastrointestinal symptoms		
Yes	59	23.6
No	191	76.4
Palpitation		
Yes	139	55.6
No	111	44.4
Cognitive dysfunction		
Yes	94	37.6
No	156	62.4
Paresthesia		
Yes	71	28.4
No	179	71.6
Weight loss		
Yes	79	31.6
No	171	68.4

in Group 1, while other diseases were detected in 20% of the patients (n=20) in Group 2. No difference was noted between the two groups in terms of the presence of other diseases. Among all included patients, 21 patients presented with neuropathic pain prior to COVID (n=12 for Group 1 and n=9 for Group 2), and no significant difference was noted between the two groups. Table 2 presents the comparison of the categorical variables between the two groups.

TABLE 2: Comparison of categorical variables between the two groups.

	Groups			
	4-12 weeks after the onset of acute disease (Group 1)	>12 weeks after the onset of acute disease (Group 2)	Test statistics	p value
Gender				
Female	64 (49.2)	79 (65.8)	7.026	**0.008***
Male	66 (50.8)	41 (34.2)		
Hospitalization				
Yes	15 (11.5)	28 (23.3)	5.295	**0.021****
No	115 (88.5)	92 (76.7)		
Intensive care				
Yes	2 (1.5)	7 (5.8)	---	0.092***
No	128 (98.5)	113 (94.2)		
Pulmonary involvement				
Yes	24 (18.5)	37 (30.8)	5.178	**0.023***
No	106 (81.5)	83 (69.2)		
Neuropathic pain				
Yes	120 (92.3)	98 (81.7)	5.413	**0.020****
No	10 (7.7)	22 (18.3)		
Fatigue				
Yes	101 (77.7)	85 (70.8)	1.541	0.214*
No	29 (22.3)	35 (29.2)		
Chest pain				
Yes	29 (22.3)	50 (41.7)	10.819	**0.001***
No	101 (77.7)	70 (58.3)		
Joint pain				
Yes	53 (40.8)	69 (57.5)	6.991	**0.008***
No	77 (59.2)	51 (42.5)		
Myalgia				
Yes	77 (59.2)	68 (56.7)	0.168	0.682*
No	53 (40.8)	52 (43.3)		
Headache				
Yes	27 (20.8)	37 (30.8)	3.318	0.069*
No	103 (79.2)	83 (69.2)		
Dyspnea				
Yes	15 (11.5)	26 (21.7)	3.959	**0.047****
No	115 (88.5)	94 (78.3)		
Gastrointestinal symptoms				
Yes	34 (26.2)	25 (20.8)	0.707	0.401**
No	96 (73.8)	95 (79.2)		
Palpitation				
Yes	75 (57.7)	64 (53.3)	0.48	0.488*
No	55 (42.3)	56 (46.7)		
Additional diseases				
Yes	25 (19.7)	20 (20)	0.165	0.568*
No	105 (80.3)	100 (80)		
Previous neuropathic pain				
Yes	12 (9.2)	9 (7.5)	0.254	0.486*
No	118 (90.8)	111 (92.5)		

*Pearson's chi-squared test; **Yates correction; ***Fisher's exact test.

A comparative analysis of quantitative data between the two groups revealed significantly higher mean age and pain severity, as determined using VAS, depression-anxiety scale, and PD-Q, in Group 2 compared to Group 1. Table 3 presents the comparison of quantitative variables between the two groups.

A comparison of categorical variables based on the presence/absence of neuropathic pain revealed no sex-related differences, while significant differences were noted in the parameters of time elapsed since the onset of acute disease, previous hospitalization, ICU admission, and pulmonary involvement. Neuropathic pain was detected in 31.3% (n=10) of patients in Group 1 and 68.8% (n=22) of patients in Group 2. A statistically significant difference was noted between the patients with or without neuropathic pain in terms of dyspnea and cognitive dysfunction ($p<0.001$ and $p=0.004$, respectively). Table 4 presents the comparison of categorical variables based on the neuropathic pain status.

The univariate analysis revealed the duration of symptoms as an independent risk factor for neuropathic pain. It was observed that with the increase in the duration of symptoms, the risk of neuropathic pain increased by 1.194 times ($p=0.003$). The risk of neuropathic pain in Group 1 was 0.371 times lower than that in Group 2 ($p=0.014$). Moreover, the risk of neuropathic pain in patients with previous hospitalization and ICU admission during the disease was 4.288 times ($p<0.001$) and 16.538 times ($p<0.001$) higher, respectively. The risk of neuropathic pain was 5.233 times higher in patients with pulmonary involvement ($p<0.001$). Table 5 presents the results of the logistic regression analysis of the risk factors affecting neuropathic pain in COVID-19 patients.

DISCUSSION

Certain COVID-19 patients experience long-term symptoms after recovery from the disease, and the precise reason for this remains unknown to date. The present study aimed to investigate the presence of neuropathic pain and other clinical symptoms in patients who had recovered from COVID-19. Persistent symptoms have been reported in other similar studies. An Italian study with a mean follow-up of 60 days following the onset of symptoms reported that 125 patients among the included 143 COVID-19 patients who were discharged from the hospital exhibited persistent symptoms, with fatigue (53.1%), dyspnea (43.4%), and worsened quality of life (44.1%) among the most frequently reported symptoms.[11] A French study on 150 patients with non-critical COVID-19 reported that two-thirds of these patients continued to present symptoms even after 60 days of follow-up.[12] The cohort examined in the present study demonstrated a similar pattern of symptoms.

In the present study, patients were grouped based on the time elapsed after acute illness, followed by a comparison between the two groups. It was revealed that VAS, PD-Q, and depression-anxiety scale scores were significantly higher in patients with symptoms persisting for over 12 weeks after acute illness. In addition, the risk of neuropathic pain was higher in patients with hospitalization, admission to

TABLE 3: Comparison of quantitative variables between the two groups.

	Groups				
	4-12 weeks after the onset of acute disease (Group 1)		>12 weeks after the onset of acute disease (Group 2)		
	$\bar{X}$±SD	Median (minimum-maximum)	$\bar{X}$±SD	Median (minimum–maximum)	p value
Age	45.47±15.53	44.5 (16-83)	51.54±14.68	53.5 (16-81)	**0.002**
VAS	46.54±15.29	50 (20-80)	54.58±16.65	60 (20-90)	**<0.001**
Depression Anxiety Scale	10.07±4.97	9 (5-32)	12.6±7.45	10 (5-38)	**0.013**
PainDETECT Questionnaire	14.45±4.03	15 (8-30)	24.63±4.77	21 (8-32)	**0.027**

Mann-Whitney U test; X±SD; Median (minimum-maximum); VAS: Visual analog scale; SD: Standard deviation.

TABLE 4: Comparison of categorical variables based on the neuropathic pain status.

	Neuropathic pain			
	Positive	**Negative**	**Test statistics**	**p-value**
Gender			0.000	**1.000***
Female	18 (56.3)	125 (57.3)		
Male	14 (43.8)	93 (42.7)		
Groups			5.413	**0.020***
Group 1 (Subacute-prolonged COVID-19)	10 (31.3)	120 (55)		
Group 2 (Chronic-post COVID-19)	22 (68.8)	98 (45)		
Hospitalization			12.316	**<0.001***
Yes	13 (40.6)	30 (13.8)		
No	19 (59.4)	188 (86.2)		
Intensive care			24.271	**<0.001****
Yes	6 (18.8)	3 (1.4)		
No	26 (81.3)	215 (98.6)		
Pulmonary involvement			18.249	**<0.001***
Yes	18 (56.3)	43 (19.7)		
No	14 (43.8)	175 (80.3)		
Fatigue			0.539	0.463*
Yes	26 (81.3)	160 (73.4)		
No	6 (18.8)	58 (26.6)		
Chest pain			1.903	0.168*
Yes	14 (43.8)	65 (29.8)		
No	18 (56.3)	153 (70.2)		
Joint pain			4.966	**0.026***
Yes	22 (68.8)	100 (45.9)		
No	10 (31.3)	118 (54.1)		
Myalgia			0.000	1.000*
Yes	19 (59.4)	126 (57.8)		
No	13 (40.6)	92 (42.2)		
Headache			7.487	**0.006***
Yes	15 (46.9)	49 (22.5)		
No	17 (53.1)	169 (77.5)		
Dyspnea			17.799	**<0.001***
Yes	14 (43.8)	27 (12.4)		
No	18 (56.3)	191 (87.6)		
Gastrointestinal symptoms			1.851	0.174*
Yes	4 (12.5)	55 (25.2)		
No	28 (87.5)	163 (74.8)		
Palpitation			1.065	0.302*
Yes	21 (65.6)	118 (54.1)		
No	11 (34.4)	100 (45.9)		
Orthostatic intolerance			2.918	0.088*
Yes	24 (75)	125 (57.3)		
No	8 (25)	93 (42.7)		
Cognitive dysfunction			8.519	**0.004***
Yes	20 (62.5)	74 (33.9)		
No	12 (37.5)	144 (66.1)		
Paresthesia			3.431	0.064*
Yes	14 (43.8)	57 (26.1)		
No	18 (56.3)	161 (73.9)		
Weight loss			1.903	0.168*
Yes	14 (43.8)	65 (29.8)		
No	18 (56.3)	153 (70.2)		

Yates correction; ** Fisher's exact test; * Pearson's chi-squared test.

TABLE 5: Results of the logistic regression analysis of risk factors affecting neuropathic pain.

	Univariate analysis	
	OR (95% CI)	p-value
Age	1.013 (0.988-1.037)	0.316
Gender (Reference: Male)	0.957 (0.453-2.021)	0.907
Symptom duration	1.194 (1.062-1.342)	**0.003**
Group (Reference: Lasting for >12 weeks after the onset of acute disease)	0.371 (0.168-0.821)	**0.014**
Hospitalization (Reference: No)	4.288 (1.919-9.579)	**<0.001**
Intensive care (Reference: No)	16.538 (3.901-70.113)	**<0.001**
Pulmonary involvement (Reference: No)	5.233 (2.413-11.347)	0.994
Visual analog scale	1.033 (1.009-1.058)	0.607
Depression Scale	1.107 (1.054-1.163)	**<0.001**
Fatigue (Reference: No)	1.571 (0.615-4.01)	0.345
Chest pain (Reference: No)	1.831 (0.859-3.9)	0.117
Joint pain (Reference: No)	2.596 (1.174-5.74)	**0.018**
Myalgia (Reference: No)	1.067 (0.502-2.27)	0.866
Headache (Reference: No)	3.043 (1.418-6.531)	**0.004**
Dyspnea (Reference: No)	5.502 (2.457-12.323)	**<0.001**
Gastrointestinal symptom (Reference: No)	0.423 (0.142-1.261)	0.123
Palpitation (Reference: No)	1.618 (0.744-3.517)	0.225
Orthostatic intolerance (Reference: No)	2.232 (0.96-5.191)	0.062
Cognitive dysfunction (Reference: No)	3.243 (1.504-6.995)	**0.003**
Paresthesia (Reference: No)	2.197 (1.026-4.702)	**0.043**
Weight loss (Reference: No)	1.831 (0.859-3.9)	0.117

In the multivariate model, the Backward Wald method was used to include the independent variables in the model; OR: Odds ratio; CI: Confidence interval.

the ICU, and lung involvement during the course of the disease. These findings corroborated that COVID-19 is a risk factor for the development of neuropathic pain.

Neurological complications in patients infected with SARS-CoV-2 arise due to the direct invasion of the nervous system, autoimmune mechanisms, and systemic and metabolic adverse effects due to the associated critical diseases.[4] An increase in the levels of proinflammatory cytokines in the circulation results in a cytokine storm and contributes to the development of these neurological symptoms.[13,14] Moreover, drugs used during the treatment procedure and prolonged ICU stays reportedly lead to systemic neuropathy, prone position-related neuropraxia, and severe axonal damage.[15] Further, central sensitization might arise due to post-traumatic stress disorder and depression associated with the adverse social and psychological effects of the pandemic, and the cerebrovascular disease related to COVID-19 could be the source of central pain.[16,17]

The prevalence of neurological symptoms in COVID-19 patients has been reported in several studies. In a study conducted with 214 patients, neurological symptoms were reported in 36.4% of patients and were more common in older patients, patients with extensive involvement of the respiratory system, and those who were more susceptible to comorbid conditions.[9] In the present study, patients with previous hospitalization, ICU admission, and pulmonary involvement were revealed to be at a higher risk of developing neuropathic pain.

A relatively larger study that investigated 3,744 COVID-19 patients reported that approximately 80% of the patients hospitalized for COVID-19 developed neurological symptoms. The most commonly reported symptoms were headache (37%) and anosmia or ageusia (26%), and the most common neurological symptoms and/or syndromes were acute encephalopathy, coma, and stroke.[18] Certain previous studies have reported an association of clinical neurological symptoms with significantly higher rates of in-hospital mortality, delirium, and disability.[19,20]

Correia et al. reviewed seven relevant studies and reported headache as the most common concomitant neurological symptom.[21] The other notable symptoms were vomiting, dizziness, altered consciousness, and epileptic crises. Significantly, 1.2% of the patients had neuropathic pain. Özdağ Acarli et al. analyzed neurological symptoms in patients and concluded that headache (52.1%) was the most prevalent neurological symptom of COVID-19, followed by encephalitis, epilepsy, disorientation, altered awareness, loss of taste and smell, and acute cerebrovascular illness. In addition, 1.3% of the cases had developed neuropathic pain.[22] In a recent retrospective study conducted in Türkiye, COVID-19 patients were assessed via telerehabilitation over a period of 1.5-3 months post-COVID-19, and it was discovered that the factors associated with neuropathic pain were female gender, asthenic body structure, cough, sore throat, anosmia, headache, myalgia, and elevated ferritin levels at the baseline. In addition, a strong association between headache and neuropathic pain was

reported. Moreover, patients with neuropathic pain were reported to have greater symptoms of pain in the neck, back, and extremities.[23]

In a previous study, a patient investigated for post-COVID neuropathic pain was revealed to have a complex regional pain syndrome.[24] In another study, neuropathic pain was revealed as a consequence of COVID-19.[25] Another study conducted using a telephone questionnaire-based survey reported that the frequency of neuropathic pain with COVID-19 patients, was 25%.[23] In the present study, the frequency of neuropathic pain was 12.8% in COVID-19 patients.

CONCLUSION

The study, as with all research, had certain limitations. First, the results obtained are applicable only to previously hospitalized mild-to-moderate severity COVID-19 survivors. Second, the laboratory parameters, which could also be associated with neuropathic pain, of these patients were not analyzed in the study.

Several patients who recover from COVID-19 may develop neuropathic pain-related symptoms in the post-disease period. Fatigue, myalgia, and joint pain are the most common symptoms among patients during the post-COVID-19 period. The incidence of neuropathic pain in these patients is 12.8%, and it is highly significant. Therefore, it is recommended that, along with the neurological symptoms related to COVID-19, studies should also investigate the etiology and incidence of neuropathic pain during the post-COVID-19 period. In particular, the patients should be carefully examined for the above-stated conditions that could increase the risk of neuropathic pain.

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