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Can isolated sudden sensorineural hearing loss (SSNHL) and idiopathic acute facial paralysis (Bell's palsy) be symptoms of COVID-19?

Mehmet Aslan [*,1], Mehmet Turan Çiçek [2]

Department of Otorhinolaryngology Head and Neck Surgery, Inonu University Faculty of Medicine, Malatya, Turkey

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ABSTRACT

Objectives: The symptoms of COVID-19 at the time of presentation mainly include fever, cough, respiratory distress and myalgia. On the other hand, as neurological symptoms, disruption of taste and smell and cerebro-vascular pathologies are well-known, whereas other neurological symptoms and signs are being newly recognized. Sudden-onset sensorineural hearing loss (SSNHL) and idiopathic acute facial paralysis (Bell's palsy) are otologic emergencies that are frequently encountered by otorhinolaryngology specialists. Although there are many articles describing SSNHL and Bell's palsy in the literature, the literature describing their relationship to COVID-19 is limited. In our study, we aimed to present the neuro-otologic relationship of SSNHL and Bell's palsy with COVID-19.

Material and methods: The pretreatment real-time oronasopharyngeal PCR tests, COVID-19 symptomatology and COVID-19 infection statuses of patients who presented to our clinic with isolated SSNHL and Bell's palsy between April 2020 and April 2021 were questioned, and the data of the patients were collected. Throughout their treatment, the patients were followed-up in terms of COVID-19 infection. This is a prospective study. Moreover, to observe the change in the incidence, the data of patients visiting between January 2019 and January 2020 were also collected. The data of the patients were statistically analyzed using SPSS.

Results: The study included a total of 177 patients. The SSNHL group consisted of 91 patients, and the Bell's palsy group consisted of 86 patients. Neither group showed a statistically significant difference in comparison to the year without the pandemic in terms of the patient numbers (incidence), sex, age, morbidity, response to treatment or social habits. There was a statistically significant difference in age only in the Bell's palsy group, but this difference was not medically significant.

Conclusion: As a result of our study, we did not observe a relationship between COVID-19 and cases of SSNHL and Bell's palsy. It is recommended to apply standard otologic treatment to isolated SSNHL and Bell's palsy patients whose association with COVID-19 is not determined.

1. Introduction

The SARS-CoV-2 (COVID-19) virus was detected firstly in the city of Wuhan in China in December 2019 and has caused a global pandemic by its rapid spread. After exposure to this virus, highly variable clinical symptoms may develop within the next 2–14 days. The most prevalent symptoms are fever, cough, shortness of breath, throat ache, headache, muscle pain and disruption of taste and smell. In geriatric and immunosuppressed patients, the disease may result in acute respiratory distress, multiorgan failure, and eventually, death. Sudden sensorineural hearing loss (SSNHL) and idiopathic acute facial paralysis (Bell's palsy) are known complications of a set of viral infections, but very little information exists in the literature about their association with COVID-19.

SSNHL is defined as at least 30 dB of hearing loss in at least three consecutive frequencies developing within 3 days [1], and its global annual incidence is 5–160 cases per 100,000 individuals [2]. In most cases, the etiology of the hearing loss is not clear, and it is attributed to

different pathologies such as viral, immune-mediated, cellular stress response and vascular blockage conditions [3]. Viruses causing hearing loss, mainly types of herpes viruses and cytomegalovirus, have been defined, but these have rarely been considered as a cause of SSNHL [4].

Idiopathic acute facial paralysis is a problematic condition that usually develops in clinical practice and has potential aesthetical and functional effects. It is generally known as Bell's palsy, and it is defined as an acute, unilateral facial paralysis characterized by the lower motor neuron dysfunction of the facial nerve [5]. The relationship of both groups of diseases with COVID-19 is mainly in the form of case reports, and this relationship needs to be clarified in the literature. Sriwijitalai and Wiwanitkit reported the first case of hearing loss in a COVID-19 patient in Thailand in April 2020 [6], and similar case reports have been published since. The isolated reports of Bell's palsy in the literature are rare, and these have usually been reported as Guillain-Barre syndrome and/or a variant of it in the form of facial diplegia and/or weakness.

While both diseases are oto-neurological emergencies, steroids are effectively used in their treatments. Herman et al. published the guidelines of the French Society of Otorhinolaryngology on steroid use in the pandemic process [7]. In our study, by examining the relationship between COVID-19 and the conditions of SSNHL and Bell's palsy, we aimed to investigate the effects of the current pandemic on the incidence of these diseases.

2. Material and methods

The pretreatment real-time oronasopharyngeal PCR tests, COVID-19 symptomatology and COVID-19 infection statuses of patients who presented to our clinic with isolated SSNHL and Bell's palsy between April 2020 and April 2021 were questioned, and the data of the patients were collected. Throughout their treatment, the patients were followed-up in terms of COVID-19 infection. The data in this study consisted of the data of the patients who had follow-ups until their post-treatment period among all patients. In this sense, this is a prospective study. Moreover, to observe the change in the incidence, the data of patients visiting between January 2019 and January 2020 were also collected. In terms of the etiological assessments of the existing conditions of the patients after their admission to the clinic, hematological and biochemical laboratory examinations, examinations regarding viral etiology, ELISA examinations and a battery of Magnetic Resonance tests were carried out. Throughout the period in which the patients received treatment, their follow-ups were performed at the service and/or at the polyclinic. In their follow-up period, the patients were examined in terms of their COVID-19 infection statuses and symptoms, and their data were recorded.

The data of the study were analyzed by using the SPSS (Statistical Package for the Social Sciences) 17.0 software. Percentages, means and standard deviations were calculated for the data. As the variables were found to be normally distributed according to the result of the Shapiro-Wilk test that was conducted ($p > 0.05$), parametric tests were used in the analysis. Independent-samples t-test was used to compare two groups. Chi-squared tests were used to compare the qualitative variables.

Approval for the study was obtained from the İNÖNÜ ÜNİVERSİTESİ BİLİMSEL ARAŞTIRMA VE YAYIN ETİĞİ KURULU Sağlık Bilimleri Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu Scientific Research and Publications Ethics Board (Decision No.: 2021/1699).

3. Results

The study included a total of 177 patients including 91 in the SSNHL group and 86 in the Bell's palsy group. The SSNHL group was divided into two groups within itself, where the first group included 49 patients from the period between January 2019 and January 2020 (n_1), and the second group included 42 patients from the period between April 2020

and their prospective follow-up by April 2021 (n_2). The Bell's palsy group was also divided into two groups within itself, where the first group included 43 patients from the period between January 2019 and January 2020 (n_3), and the second group included 43 patients from the period between April 2020 and their prospective follow-up by April 2023 (n_4). According to the intragroup analysis results, there was no statistically significant difference in the incidence in the SSNHL group between the previous year and the next ($p = 0.746$). In the same group, there was also no significant difference in terms of age, sex, treatment outcomes, morbidity and social habits between the previous year and the next (Table 1).

Furthermore, according to the intragroup analysis results on the Bell's palsy group, there was no statistically significant difference in incidence between the previous year and the next. In the same group, there was a significant difference in terms of age in comparison to the previous year ($p = 0.012**$), whereas there was no significant difference in terms of sex, treatment outcomes, morbidity and social habits (Table 2).

The results of our study may be listed as follows:

- There was no significant difference between the numbers of SSNHL patients in the periods of January 2019 to January 2020 (n_1) and April 2020 to April 2021 (n_2) ($n_1 = 49$, $n_2 = 42$, $p = 0.746$).
- There was no significant difference between the numbers of Bell's palsy patients in the periods of January 2019 to January 2020 (n_3) and April 2020 to April 2021 (n_4) ($n_3 = 43$, $n_4 = 43$).
- There was no significant difference in terms of age, sex, morbidity, treatment response and social habits between the SSNHL patients in the periods of January 2019 to January 2020 (n_1) and April 2020 to April 2021 (n_2) (Table 1).
- There was no significant difference in terms of sex, morbidity, treatment response and social habits between the Bell's palsy patients in the periods of January 2019 to January 2020 (n_3) and April 2020 to April 2021 (n_4) (Table 2). However, there was a statistically significant difference between these groups based on age ($p = 0.012**$, Table 2). This statistically significant difference between the groups in terms of age did not contradict the information in the literature, and it was not medically significant.
- Throughout the study, for the patients who presented with SSNHL and Bell's palsy, pre-treatment real-time oronasopharyngeal PCR tests and COVID-19 statuses were questioned. Additionally, the patients were also examined in terms of their potential COVID-19 symptoms. In both main groups of patients, no COVID-19 PCR positivity or symptomatology was observed at the time of their presentation to the clinic of at the time of diagnosis. It was seen that the sudden hearing loss and Bell's palsy were isolated symptoms, and they were recorded.
- Throughout the study, standard treatment protocols were applied on the SSNHL and Bell's palsy patients, and the patients were followed-up through their treatment process. No COVID-19 signs or symptoms were observed in the follow-ups of the patients in both groups.
- Considering the period where the study was conducted, the vaccination schedule for COVID-19 had just started in Turkey, and any effect of vaccination or similar efforts on the results of this study was out of the question.

4. Discussion

Sudden sensorineural hearing loss (SSNHL) is categorized as a medical emergency due to the discomfort it causes in the patient and its requirement of urgent treatment. In this case, hearing loss was defined as at least 30 dB of sensorineural hearing loss in at least 3 consecutive frequencies developing in a shorter time than 72 h [8]. For sudden hearing loss, classically three potential pathophysiological mechanisms have been defined: microcirculation disorders, idiopathic viral infection and localized immune progression [2]. While both ears are similarly

Table 1

Incidence and demographic data of sudden sensorineural hearing loss (SSNHL).

	2019 January–2020 January (n₁)		2020 April–2021 April (n₂)		P value
Number of patients	49		42		0,746
Age (median ± st. deviation)	50,7347 ± 17,40902		45,9524 ± 15,61418		0,174
Gender	Female	Male	Female	Male	
	17 (%34,7)	32 (%65,3)	13 (%31,0)	29 (%69,0)	
Treatment results	Number of patients recovered	Number of patients not recovered	Number of patients recovered	Number of patients not recovered	0,746
	25	24	22	20	
Morbiditiy	Morbiditiy+	Morbidity−	Morbiditiy+	Morbidity−	
	14 (%29,6)	35 (%71,4)	15 (%36,7)	25 (%64,3)	
Social habits (smoke/ alcohol…)	Positive	Negative	Positive	Negative	
	19 (%38,8)	30 (%61,2)	16 (%38,5)	26 (%61,5)	

$p < 0,05**$ was considered statistically significant.

Table 2

Incidence and demographic data of idiopathic acute facial paralysis (Bell's).

	2019 January–2020 January (n₃)		2020 April–2021 April (n₄)		P value
Number of patients	43		43		
Age (median ± st. deviation)	54,3256 ± 17,77468		44,2558 ± 18,44695		0,0,012**
Gender	Female	Male	Female	Male	
	20 (%46,5)	23 (%53,5)	19 (%44,2)	24 (%55,8)	
Treatment results	Number of patients recovered	Number of patients not recovered	Number of patients recovered	Number of patients not recovered	0,746
	25	24	22	20	
Morbiditiy	Morbiditiy+	Morbidity−	Morbiditiy+	Morbidity−	
	16 (%37,2)	27 (%62,8)	14 (%32,55)	29 (%67,45)	
Social habits (smoke/ alcohol…)	Positive	Negative	Positive	Negative	
	10 (%23,3)	33 (%76,7)	15 (%34,88)	28 (%65,11)	

** $p < 0,05$ was considered statistically significant.

susceptible to sudden hearing loss, there is unilateral loss in most hearing loss patients. Simultaneous bilateral or second ear involvement is very rare, and in such cases, clinicians should focus on causes such as vascular, metabolic, autoimmune, infectious, neoplastic, ototoxic, traumatic or inflammatory causes as the main ones [8]. Hearing losses developing due to viral causes are typically sensorineural, and some may recover after the infection [9]. Hearing loss caused by viruses may be mild, moderate or severe and unilateral or bilateral. Considering different types of viruses, the mechanisms held responsible in this process include direct injury of the structures of the inner ear including inner hair cells and the organ of Corti (the measles virus is classically the most well-known virus) and indirect injury caused by the immune response against the virus [9–13]. While hearing loss secondary to viral infections are generally intracochlear, sometimes, the auditory centers of the brain stem are also affected. Some mechanisms of the peripheral auditory centers being affected from viruses may be listed as damage induced directly in the intracochlear structure by the virus, damage the virus induces via the stria vascularis or the spiral ganglion, damage the virus induces in the immune system of the host (Cytomegalovirus) and damage that occurs through secondary bacterial infection in cases where immunity is compromised (HIV and Measles) [10].

Several hypotheses have been proposed on the pathophysiology of COVID-19 in terms of hearing and mechanisms that can lead to the atypical symptoms of the disease, and among potential etiologies, researchers have implicated disruption in the auditory centers of the temporal lobe in relation to viral pathophysiology mediated by the angiotensin-converting enzyme 2 (ACE2) receptors, involvement of the internal microvascular structure of the inner ear or the auditory center or injuries of the intracochlear structure (cochlear hair cells) [9,14–16]. According to the theory on viral adhesion to the ACE2 receptors, a potential cause of neurological involvement is the excessive expression of this protein in the brain. If the auditory center in the temporal lobe is damaged, hearing loss may occur [14]. Another hypothesis involves the emergence of changes caused by a microvascular thrombus or embolus secondary to COVID-19 that can form ischemic lesions in the inner ear or

auditory centers [14]. COVID-19 infection has been associated with various complications related to both venous and arterial thrombosis, as well as multiorgan failure. It was argued that this virus can lead to endotheliitis in the auditory center of the temporal lobe, the cochlear nerve and/or cochlear tissues [15]. Sriwijitalai and Wiwanitkit reported the first case of hearing loss in a COVID-19 patient in April 2020 in Thailand, and they stated that the relationship between COVID-19 and hearing loss needs to be investigated [6]. Since then, similar case reports have been published [17]. Chern et al. reported a case of intra-labyrinthine hemorrhage developing as a consequence of micro-thrombotic events and bilateral sudden hearing loss and vertigo related to this in a patient who was proven to have had COVID-19 infection through Ig G antibodies [18].

The first study on this topic started by Kılıç et al. conducting simultaneous PCR screening of 5 patients presenting with SSNHL and finding that one patient had a positive COVID-19 test, where it was claimed that COVID-19 and SSNHL are associated, and COVID-19 could increase the incidence of SSNHL [19]. In their letter to the editor as a response to criticisms of their study, Kalcıoğlu et al. emphasized that the relationship between sudden hearing loss and COVID-19 could be overlooked due to healthcare services that have been interrupted in the current pandemic period [20]. In their comments on the study by Kılıç et al., Luca et al. stated that no serious increases in case numbers were reported in the pandemic period regarding hearing loss, the result in the study by Kılıç et al. could be coincidental, and it needed to be investigated [21]. Chari et al. found the incidence of SSNHL similar between March and May in the pandemic period and the same months in the previous year and stated that the COVID-19 virus does not lead to an increase in the incidence of SSNHL [22]. In a study conducted by Mustafa, while no significant difference could be determined between asymptomatic COVID-19 patients and healthy individuals in terms of their pure tone audiometry results at low frequencies, worse results were reported in the COVID-19 patients at high frequencies and in transient evoked otoacoustic emissions (TEOAE), and it was argued that COVID-19 and the cochlea could be associated [9]. Koumpa et al. reported

unilateral sudden hearing loss in a patient who was being monitored in the service after intensive care treatment due to COVID-19 and stated that the hearing loss was not among the symptoms found in the patient at the time they presented to the hospital [23]. In their study on 155 patients, Elibol reported that, in the otolaryngological sense, cough, anosmia and throat ache were the most frequently stated symptoms in COVID-19, and sudden hearing loss and facial paralysis were observed in one patient each [24]. However, the patients in their study were retrospectively examined, there were no audiological data indicating sudden hearing loss or otolaryngological examination findings that would confirm facial paralysis, and their results were based on patient statements. In our study, we determined that the incidence of SSNHL did not vary to a statistically significant extent.

Idiopathic acute facial nerve paralysis (Bell's palsy) is an acute, unilateral facial paralysis characterized by the lower motor neuron dysfunction of the facial nerve [5]. The condition is generally self-limiting, and the symptoms usually recover within weeks or months. Nevertheless, in very few cases, it may lead to sequelae such as long-term facial muscle weakness, ocular dryness, lagophthalmos, keratopathy or swallowing dysfunction [25]. The condition is generally fixed without treatment, but typically, if it is diagnosed especially within the first 72 following symptom onset, antiviral and corticosteroid treatments are used [26]. Facial nerve paralysis is prevalently associated with HSV, VZV, HIV, Lyme disease and *Mycobacterium* tuberculosis. Noncontagious causes include sarcoidosis and neoplasms. The exact pathogenesis of idiopathic acute facial nerve paralysis is still uncertain, but it is thought that it is associated with axonal diffusion and viral replication causing inflammation and demyelination related to neurotrophic herpesviruses (HSV and VZV) [27].

As causes of the neurological picture of COVID-19, direct injury from the infection, hypoxia, ACE2 receptors, immune injury [28], immunomodulator treatment and gut microbial translocation [29], necrotizing encephalitis as an intracranial reflection of cytokine storms [30], and cerebrovascular pathologies with prothrombotic and proinflammatory factors [31,32] are implicated. Lima et al. reported 8 cases with positive COVID-19 PCR test results and facial paralysis between May and July 2020. According to their article, while the facial nerve paralysis was an initial symptom in 3 patients, it emerged between 2 and 10 days following COVID-19 infection in 5 patients. The authors reported that, according to the House-Brackmann scale, 5 patients had grade-2, and 3 patients had grade-3 facial paralysis, and they claimed that acute facial paralysis may be related to COVID-19 [33]. Figueiredo et al. presented a case with left peripheral facial paralysis and a positive COVID-19 PCR test result after excluding other potential causes in a late-period term pregnant woman. They emphasized that pregnancy presents an increased risk of facial paralysis, but they stated that facial paralysis may also be associated with COVID-19 after excluding other potential causes [34]. Goh et al. reported a case of left peripheral facial paralysis in a patient receiving treatment due to COVID-19 on the 6th day and stated that isolated cranial nerve involvement should be kept in mind in COVID-19 [35]. On the other hand, considering studies in the literature, we see that most cases of COVID-19-associated facial paralysis/paresis have been explained by Guillain-Barre syndrome that could be considered infectious and/or neurological symptoms associated with its variants. Most cases developed after COVID-19 infection and had a clinical picture including polyradiculoneuropathies in the form of facial weakness or facial diplegia [36]. In a case they reported on, Ottaviani et al. expressed that the existing polyradiculoneuropathy resembled a picture like the Zika virus [37]. Muras et al. reported bilateral facial diplegia in a patient with EBV and COVID-19 coinfection and stated that the pathology could be a neurological variant of GBS [38]. In our study, we determined that the incidence of Bell's palsy did not change to a statistically significant extent.

In the treatment of sudden sensorineural hearing loss and Bell's palsy, using steroids is the most effective treatment modality. However, the use of steroids in confirmed or suspected COVID-19 cases in the pandemic period is under debate. Two reviews published in February and March in the Lancet stated based on experiences on corticosteroids in terms of previous influenza and other virus cases that they delay viral RNA clearance and did not reduce mortality, and they provided their recommendation that corticosteroids should not be used in these cases [39]. On the other hand, a study conducted between March 2020 and June 2020 at the University of Oxford determined that steroids reduced the rate of mortality in especially ventilated patients and/or those receiving oxygen support, whereas they did not have a positive effect on mortality in patients not needing oxygen support [40]. According to Herman et al., based on the mutual report of the French Association of Otology and Oto-Neurology and the French Society of ENT and Head and Neck Surgery, it is not possible to accept Bell's palsy and SSNHL as isolated symptoms/signs of COVID-19, and corticosteroids that are known to be beneficial in these cases shall be used [7].

5. Conclusion

According to the results of our study and those reported in the literature:

- COVID-19 test positivity or COVID-19 symptomatology was not identified in the patients who presented with isolated SSNHL and Bell's palsy.
- There was no significant difference in the numbers of patients who presented with isolated SSNHL and Bell's palsy to our clinic between the one-year period during the pandemic and the one-year period before the pandemic.
- Additionally, the finding in the literature that the relationship of isolated SSNHL and Bell's palsy with COVID-19 is relatively limited and idiopathic in comparison to loss of taste and smell supported the view that their relationship to COVID-19 is weak/nonexistent.
- In our study, the number of patients presenting with SSNHL in the one-year period during the pandemic decreased compared to the previous year, but this difference was not significant. This situation brings to mind two possibilities. First of all, the patients' reception of healthcare services might have been interrupted due to the pandemic. Second of all, the existing restrictions and protective measures might have reduced the number of patients experiencing SSNHL with a viral etiology.
- If there are no laboratory or clinical symptoms/signs indicating COVID-19 in patients presenting with isolated SSNHL and Bell's palsy, it is recommended to provide these patients with standard otologic treatment approaches.

Author's individual contributions

Mehmet Aslan MD. Lecturer: Surgeon, author, analysis, critical review, literature search, data collection.

Mehmet Turan Çiçek MD. Lecturer: Analysis, literature search, critical review, author.

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Declaration of competing interest

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