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## Could sudden sensorineural hearing loss be the sole manifestation of COVID-19? An investigation into SARS-CoV-2 in the etiology of sudden sensorineural hearing loss



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### ABSTRACT

**Objective:** This study aimed to investigate the presence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in patients presenting with only sudden sensorineural hearing loss (SSNHL) during the COVID-19 pandemic.

**Methods:** The study included five male patients who presented with the sole complaint of unilateral SSNHL to the otolaryngology outpatient clinic between 03–12 April 2020. The patients were referred to the infectious diseases clinic to be evaluated for SARS-CoV-2 by real time polymerase chain reaction (RT-PCR) testing.

**Results:** RT-PCR testing for SARS-CoV-2 was positive in one of the patients and negative in the other four patients. A positive response to COVID-19-specific treatment in the SARS-CoV-2 positive SSNHL patient was noted.

**Conclusion:** It should be remembered that non-specific symptoms such as SSNHL could be the only sign with which to recognize a COVID-19 case. Awareness of such a non-specific presentation of COVID-19 patients is crucial during this pandemic period for preventing infectious spread through isolation and early initiation of COVID-19 targeted treatment.

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### Introduction

Emerging in Wuhan, China, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for coronavirus disease (COVID-19), has been causing deaths from pneumonia and respiratory failure and was eventually declared a pandemic. It was identified as a clade of the family of coronaviruses, isolated from human airway epithelial cells (Zhu et al., 2020) and reported as transmitted through droplets and direct contact, with an incubation period of 2–7 days extending up to 14 days (Rubin et al., 2020; Gralinski and Menachery, 2020;

Duarte et al., 2020; Carlos et al., 2020; Morse et al., 2020). The disease may be asymptomatic in about a third of the cases, accelerating the spread of the disease (Lai et al., 2020; Cao et al., 2020; Wu et al., 2020). The most common symptoms that accompany COVID-19 include fever, cough, sore throat, headache, muscle pain, diarrhea, and dyspnea. During the spread of the infection, nonspecific taste and smell disturbances have also been included in the spectrum of the symptoms (Vaira et al., 2020; Mao et al., 2020).

Viruses are known to cause neurological manifestations, such as anosmia, facial paralysis and sudden sensorineural hearing loss (SSNHL) (Kennedy, 2010; Cohen et al., 2014; Mateer et al., 2018). During the previous SARS outbreak, coronaviruses were reported to be associated with loss of sense of smell and taste due to neural injury (de Haro-Licer et al., 2013; Suzuki et al., 2007). However, it is believed that no reports of SSNHL have appeared in the literature associated with the COVID-19 pandemic. Identification of patients

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presenting with non-specific symptoms during the pandemic may play an important role in breaking the infection chain and reducing transmission. Given the previous literature data on coronavirus-associated SSNHL, this study aimed to investigate the presence of SARS-CoV-2 in patients presenting with only SSNHL during this pandemic.

## Materials and methods

The study protocol was approved by the Clinical Research Ethics Committee of Istanbul Medeniyet University Goztepe Training and Research Hospital (April 9, 2020/0188).

The subjects were eligible for the study if they presented with the sole complaint of unilateral sudden hearing loss to the otolaryngology outpatient clinic between 3 and 12 April 2020. SSNHL was defined as a hearing loss of >30 dB at three consecutive frequencies at least over a period of <3 days (Weiss et al., 2017). Audiological tests confirmed SSNHL in all the patients. The patients were then referred to the infectious diseases clinic to be assessed for SARS-CoV-2. Taking strict precautions – in a safety cabinet with disposable isolation gowns, N95 masks, gloves, and shields – pharyngeal secretion samples were collected from the oropharynx and then the nasopharynx through direct contact with swabs. The samples were sent to the laboratory for real-time polymerase chain reaction (RT-PCR) testing.

## Results

Five male patients, with a mean age of 40.8 years (range, 29–54 years), were identified. Three patients (60%) had SSNHL in the left ear, and two (40%) in the right ear. SSNHL was the only symptom present in all the patients. None of the patients had any other symptoms than SSNHL or any risk factors such as metabolic diseases, ototoxic drug usage, history of trauma, history of upper respiratory tract infections, etc.

On audiologic examination with a tuning fork at a frequency of 512 Hz, the Weber test showed lateralization to the right in patients with left-sided hearing loss and to the left in those with right-sided hearing loss. Tympanometry results were type A for all patients, indicating normal middle ear conditions. RT-PCR testing for SARS-CoV-2 was positive in one of the patients (20.0%) and negative in the remaining four patients. Pure tone audiometry findings at 250, 500, 1000, 2000, 4000 and 8000 Hz and RT-PCR results are presented in Table 1.

Due to suspicion of COVID-19, no specific treatment for SSNHL was initiated until RT-PCR test results were acquired. After receiving the results the four patients who were negative for COVID-19 commenced oral prednisolone 1 mg/kg/day tapered to

16 mg every 3 days and oral vitamin B-folic acid complex and proton pump inhibitor daily. The patient who was positive for COVID-19 received oral hydroxychloroquine 200 mg twice daily for 5 days in accordance with the Republic of Turkey's Health Ministry COVID-19 guidelines.

Due to home isolation of patients, early audiological evaluation after treatment started could not be performed. The hearing status of the patients was obtained by phone. Patient #2 with a positive test result for COVID-19 reported complete resolution of hearing complaints on day 11 of the treatment. Patients #1, #4, and #5 with negative results for COVID-19 reported complete recovery of hearing on day 10, day 11, and day 3 of the treatment, respectively. Patient #3, with a negative test result for COVID-19, reported persistence of his hearing problem on day 11 of the treatment. Control audiologic tests were performed at least 1 month after treatment and the results are shown in Table 1.

## Discussion

SARS-CoV-2 emerged in December 2019 and has caused a pandemic, with >100,000 deaths from acute respiratory failure, across the world in a couple of months. While most patients present with the predominant symptoms of fever, cough, sore throat, muscle pain, and respiratory failure, anosmia and taste disorders alone or in combination with the common symptoms were added to the clinical spectrum of COVID-19 (Vaira et al., 2020; Mao et al., 2020).

Viral infections may involve cranial nerves, leading to SSNHL, peripheral facial paralysis, or smell and taste disorders (Kennedy, 2010; Cohen et al., 2014; Mateer et al., 2018). The etiological factor for SSNHL has been reported to cover many viruses such as herpes simplex virus, human immunodeficiency virus, hepatitis virus, measles virus, rubella virus, mumps virus, Lassa virus, and enteroviruses (Cohen et al., 2014; Mateer et al., 2018).

Three mechanisms have been implicated in the occurrence of SSNHL associated with viral infections: neuritis caused by viral involvement of the cochlear nerves, cochleitis due to viral involvement of the cochlea and perilymphatic tissues, and the stress response resulting from the cross-reaction of the inner ear antigens to viral infections (Wilson, 1989). Animal studies of a variety of viruses have reported induction hearing loss by direct involvement of the inner ear structures or indirectly via cerebrospinal fluid (Nomura et al., 1985; Esaki et al., 2011; Yun et al., 2015; Cashman et al., 2018).

The current findings suggest the need for RT-PCR testing for SARS-CoV-2 due to high suspicion of neurological involvement of COVID-19 in patients who present to otorhinolaryngology outpatient clinics with the sole manifestation of SSNHL during the

**Table 1**  
Pure tone audiometry findings and RT-PCR results in patients with sudden sensorineural hearing loss.

Case	Sex	Age	Affected side		Right ear (dB) Air/Bone						Left ear (dB) Air/Bone						Additional Symptoms	RT-PCR results for SARS-CoV-2
					250	500	1,000	2,000	4,000	8,000	250	500	1,000	2,000	4,000	8,000		
1	M	41	Left	BT	20/20–	15/15	15/15	25/20	20/20	10/10	60/60	75/75	60/60	30/30	20/20	10/10	No	Negative
				AT	15/15	10/10	10/10	15/10	15/10	10/10	20/20	15/15	15/15	15/15	10/10			
2	M	29	Right	BT	60/60	50/50	40/40	20/20	10/10	10/10	10/10	10/10	10/5	5/5	5/5	5/5	No	Positive
				AT	10/10	10/10	10/10	10/10	5/5	5/5	10/10	10/10	5/5	5/5	5/5			
3	M	54	Right	BT	40/40	35/30	35/35	50/50	80/80	95/95	20/20	15/15	10/10	15/15	45/40	65/60	No	Negative
				AT	30/30	35/35	35/35	45/40	70/65	85/85	15/15	15/15	10/10	5/5	35/30	65/65		
4	M	45	Left	BT	20/20	20/20	25/25	25/25	65/65	70/70	40/40	45/45	45/45	75/75	110+/70+	110+/70+	No	Negative
				AT	10/10	15/15	15/15	15/15	65/65	55/55	15/15	15/15	20/20	35/35	100/100	105/105		
5	M	35	Left	BT	15/10	10/10	5/5	5/5	5/5	10/10	20/20	50/50	75/75	70/70	40/40	25/15	No	Negative
				AT	20/20	15/15	5/5	5/5	5/5	10/10	40/40	55/55	60/60	30/30	5/5	30/30		

Abbreviations: M, male; BT, before treatment; AT, after treatment.

COVID-19 pandemic. Given the speed at which the infection spreads, it is paramount that every possible symptom suggestive of the infection needs to be taken into consideration. One of the current patients had a positive RT-PCR test result.

An important consequence of identifying COVID-19 in the etiology of SSNHL is choosing the right treatment strategy to maximize the clinical recovery and minimize the side effects and complications. Corticosteroids play a key role in the treatment of SSNHL (Hara et al., 2018). On the other hand, for infection caused by this novel virus like many other viral infections, the use of corticosteroids could present a risk of increasing the severity of the infection and cause delayed viral clearance (World Health Organization, 2020). Investigating the presence of SARS-CoV-2 in patients with SSNHL complaints and using other alternative treatment methods in COVID-19-positive cases could prevent such undesirable consequences. The patient who was diagnosed with COVID-19 in the current study was treated with oral hydroxychloroquine 200 mg twice daily for 5 days and had complete recovery from SSNHL. The rest of the cases with negative SARS-CoV-2 RT-PCR results were treated using routine therapy, which includes corticosteroids. According to the results, the patient who had COVID-19 totally recovered at 1 month after treatment; one negative patient had a complete recovery and another had partial recovery. No significant improvement in hearing was observed in two patients (Table 1). Amongst these cases, three showed complete recovery. No improvement has been observed in the fourth case to this day.

Considering neurological involvement of SARS-CoV-2, there have been several reports addressing many different neurological manifestations, but not SSNHL. Mao et al. (2020) reported patients who presented with only nonspecific neurological symptoms such as dizziness, ataxia or stroke without smell or taste disorders, and neuralgia due to peripheral cranial nerve involvement. They emphasized the need for high levels of vigilance and evaluation of neurological manifestations in the context of SARS-CoV-2 for early diagnosis and prevention of the spread of infection through isolation, particularly in super-spreading patients. Current data suggest that the same approach may also apply to those presenting with SSNHL as the sole symptom.

Autopsy seems to represent the only way to provide a definite evidence base for better understanding of the neural impairment caused by the virus. During the previous SARS-CoV and MERS-CoV outbreaks, studies of cerebrospinal fluid have shown the presence of viral nucleic acid and autopsy studies have reported neurological involvement (Desforges et al., 2013; Arabi et al., 2017). Similarly, autopsy results of patients with SARS-CoV-2 have shown hyperemic and edematous brain tissue with neuronal degeneration (National Health Commission of the People's Republic of China, 2020).

The current study observed COVID-19 in one of five (20%) patients with SSNHL symptoms with no prior risk factors for hearing loss. This result is important in that it shows that infected patients can also present in clinics with symptoms different from the previously identified ones in the literature. During this pandemic it is important to recognize every possible symptom of the infection to break the chain of transmission. Even though the sample size is small, the current results carry importance for global public health as there have been no other reports of COVID-19 patients diagnosed with isolated SSNHL. Therefore, this study is the first to bring awareness to practitioners and researchers to look for SARS-CoV-2 positivity in patients with SSNHL. It is hoped that this study will contribute to the field of Epidemiology and the practice of Otorhinolaryngology by enabling early detection of these patients, their isolation, prevention of their infectiousness in the early period, and early and targeted medical treatment.

## Conclusion

It should be remembered that non-specific symptoms such as SSNHL could be the only sign with which to recognize COVID-19 cases. Awareness of such a non-specific presentation of COVID-19 patients is crucial during this pandemic period for the prevention of infectious spread through isolation and early initiation of COVID-19-targeted treatment and avoiding potentially harmful standard SSNHL treatment that includes prednisolone.

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