

How to Cite:

Qaloosiraqia, R. K. E., & Al-Karawi, H. A. Y. (2022). Sensorineural hearing loss during and post COVID-19 infections. *International Journal of Health Sciences*, 6(S1), 14233–14244.

<https://doi.org/10.53730/ijhs.v6nS1.8642>

Sensorineural hearing loss during and post COVID-19 infections

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Abstract---In order to learn more about the possible causes of sudden sensorineural hearing loss caused by the coronavirus disease 2019 (COVID-19), we are looking for new patients who have been diagnosed with SSNHL. The results of a comprehensive study were using the databases of PubMed and Google Scholar. Systematic Reviews and Meta-Analyses Preferred Reporting Items: Following the Prisma guidelines was done. Sensorineural hearing loss" and "+" were among the terms we searched for. Hearing loss due to sensorineural infection with SARS-CoV-2, also known as "COVID-19." "Coronavirus". Exclusion criteria were used to exclude studies from the review. Of The initial search yielded 20 articles, but only five of them met the inclusion criteria. Included in the articles were total of seven patients were studied in four case studies and one letter to the editor Patients of all ages and genders were able to participate Positive for COVID-19 and displaying SSNHL on either one or both sides hearing loss was reported by seven of the patients Five patients reported dizziness and nausea. Sensorineural deafness that appears out of nowhere (SSNHL) otolaryngologists frequently encounter this condition. The precise detailsthere is still no clear understanding of the disease's pathophysiology following a viral infection is the most likely cause infection. The most effective treatment is immediate steroids to increase the likelihood of a positive outcome. However, despite the large number of research papers in only a few studies have been published on SSNHL. after-effects hearing loss from the use of C'/+6COVID-19, None of which has been reported in the United Kingdom. This is a piece of writing. After COVID-19, this is the first known case of SSNHL in the UK. Physical examination and imaging ruled out any other possibility reason for hearing loss. a review of the literature revealed that There have been four other cases described in the past. Hearing Loss can be a major cause of morbidity and mortality and overlooked in the midst of an intensive care unit

Being monitoring for SSNHL after a positive COVID-19 result enables an early course of steroids, which provides the best results the possibility of regaining hearing. Aim: To show the COVID-19 may have an adverse effect on cochlear function.

Keywords---sudden sensorineural hearing loss, sar- cov-2, sensorineural hearing loss, coronavirus, COVID-19.

Introduction

Pneumonia cases reported in December 2019 were attributed to the zoonotic spread of a new virus linked to a major Chinese seafood market [1]. Similarities can be found. new coronavirus COVID-19 has been deemed an international pandemic by the World Health Organization (WHO), according to recent sources. 2020 [2] March 11th Fever, cough, and exhaustion are among the most common clinical signs of COVID-19. In rare cases, patients remained asymptomatic or had symptoms that were not usual; these are described in detail in a report. According to Stawicki and co-authors [3]. Some of these illnesses have been linked to viral infections in the past. neurological symptoms such as hearing loss, anosmia, and facial paralysis are among the unusual symptoms The prevalence of olfactory impairment in COVID-19 patients has been documented in various cross-sectional investigations [4]. Variations range from 33.9% to 68%. 12 percent of individuals in a research by Lechien et al. had anosmia as their initial symptom. a manifestation of the problem [5]. Despite the fact that facial nerve palsy is rarely linked to COVID-19, there have been a few cases. Other cranial nerves have been found to be occasionally affected as well [6]. A handful of people have come forward recently to say that There have been reports of COVID-19 patients with vertigo, hearing loss, and tinnitus [7-9]. In order to avoid a delay in COVID-19, clinicians must be aware of these unusual symptoms. diagnosis. Hearing loss that results from injury to the inner ear is known as sensorineural hearing loss (SSNHL). The auditory nerve or the ear [10] SSNHL is characterized by a loss of at least 30 decibels (dB) in three or more adjacent Within 72 hours [11] occurrences. There are a number of theories as to how viruses spread. If a virus enters the cochlea or fluid spaces and reactivates, it could lead to SSNHL. indirect antibody triggering by the virus or latent viral within inner ear tissues [12]. COVID-19 is Although prior research have described virus-associated hearing loss, it has not been thoroughly evaluated for its capacity to enter auditory pathways It is possible, according to SSNHL [13]. SSNHL in COVID-19 may also be caused by pharmacological ototoxicity, as well as a viral origin. There's a chance that a patient's treatment plan is to blame. Chloroquine and hydroxychloroquine are two examples of this. recognized ototoxic substances [14]. Both of these medications have long been used to combat malaria. Diseases that are long-term in nature. COVID-19 may have clinical implications, according to certain studies. HCL has been used to alleviate a variety of side effects, including tinnitus, irregular gait, and dizziness [15]. The For patients with COVID-19, the recommended dosage of both chloroquine and hydroxychloroquine is significantly reduced. Dosage is

higher than that used to treat malaria and chronic inflammation. With the goal of identifying COVID-19 positive SSNHL patients, we conducted this systematic review in order to explain potential mechanisms.

Methods

Cross-sectional studies of two hospitals, KHANAQIN GENERAL HOSPITAL, JALAWLA GENERAL HOSPITAL from October 2020 to October 2021.

A systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria (14). (14) Inclusion/Exclusion Criteria for Study Selection The inclusion criteria were original research or case reports, human studies, and studies. Included patients required confirmation of COVID-19 by polymerase chain reaction testing or antibody testing.

Inclusion:

- Direct temporal link between the new-onset of SNHL, vertigo and/or tinnitus and COVID-19 infection.
 - Established COVID-19 infection by Polymerase Chain Reaction (PCR), detection of particular antibodies by serology testing or chest CT scan indicative of COVID-19 or reported admittance to the hospital for COVID-19.
- Exclusion:** - Not established infection. - Studies containing duplicated data from other published work. - Studies reporting cases of conductive hearing loss. - No direct temporal link between audiovestibular symptoms and COVID-19.

Results

30 case reports or case series (level 4) were found in the database, totaling 230 cases of patients who have been infected with COVID-19. Audiovestibular neuritis (AVN) was first noticed in 5–19 cases.

Symptoms. The patient's age was stated in years. While the male to female ratio is 18:65, that was twelve minutes to eighteen in the morning. The period of time between the two events development of audio-vestibular symptoms after COVID-19 infection symptoms, with a maximum of six weeks period. The COVID-19 and the audio-vestibular device symptoms Meniere's disease-related deafness. The most common type of hearing loss was an SNHL. Aural-vestibular symptoms are reported in 30 of the patients. It was classified as an isolated case of SNHL out of 230 patients. linked in seven cases with tinnitus in 5 patients to tinnitus/vertigo (see Table 1). There was a first hypothesis that SNHL and SNHL were linked. and COVID-19 is scheduled for April 2020, but coincidentally, the patient was diagnosed with the disease. Neither Sriwijitalai nor Sriwijitalai's names were given. (Wiwanitkit). 5 Since then, numerous reports of similar incidents have surfaced. together with SNHL, either alone or in combination symptoms, such as ringing in the ears or dizziness, have been described. Only supposed hearing loss has been reported in some studies. various authors theorized but did not provide any evidence for this; based on a connection between COVID-19 and a probable pathology based on temporal connection moreover, the lack of any relevant medical history rather than the virus itself, the risk factors.

In general, the research that was done showed that the examination of the ear (i.e. audiometric testing) was troublesome because of the strict criteria for hygiene all

of the tools and the setting of a hospital evaluation at the end of each Pure tone audiometry was used. done on ten individuals who had recently developed. There are two publications in this series from SNHL: (Degen et al.,⁸ Chern et al.¹⁶) data from a binaural SNHL should be reported. When it comes to both of these scenarios, A brain MRI revealed evidence of impairment to the inner ear. both sides of the intra-labyrinthine bleed, Cochlear irritation on both sides. The steroid treatment of one patient was ineffective. Received a local anesthetic for a cochlear implant, in light of the fact that cochlear fibrosis has been detected the use of an MRI (Degen et al.⁸) Since the beginning of the pandemic, there has been another problem. treating diseases of the auditory and vestibular systems treatment of SNHL in particular Despite the fact that steroids are commonly given to subjects usage is restricted to those who have just been diagnosed with SNHL Be on the lookout for viral infections in the early stages the potential for inflicting harm must be taken into account delay in viral clearance and deterioration in the patient's health of the infection's effect on one's overall health. As a result, the goal is to avoid any negative consequences. intratympanic injection is the primary method for achieving systemic effects due to the low cost of administration Perilymphatic absorption is greater than systemic absorption.

Vertigo

Information on the symptoms and causes of dizziness and vertigo. Only a few cases of COVID-19 infection have been documented. a thorough vestibular examination is almost never performed. available. Six cases were documented by Malayala et al.⁶ vestibular deficiency from around the globe however, coexisting It has been confirmed that Covid 19 has been infected. six subjects in four different ways The sad truth is that These images show evidence of nystagmus. challenging any hypothesis is possible in only two cases. the link between a specific form of vestibular dysfunction neuropathy, benign positional vertigo (BPPV) Meniere's illness) and the virus Treatments with COVID-19 that cause ototoxicity Treatment for patients with COVID-19 is not uncommon. Possible ototoxic consequences may occur. 2 The usage of hydroxychloroquine, which has a wide range of off-label uses, is a hot-button issue. Early on in the pandemic, it was widely used. The audio-vestibular and vestibular systems the negative effects of quinine and compounds, such as hydroxychloroquine, are in use. During the 18th century, it has been known by the name "cinchonism" is a synonym. Today, the most important health issue is Due to a lack of proof, surveillance agencies with regards to the conceivable benefits and well-known due to possible negative effects, its use was restricted as a result of approved clinical trials that are closely monitored. Macrolide antibiotic azithromycin it was suggested because of its anti-inflammatory qualities there are numerous therapy options for COVID-19 ototoxic effects in vitro and in vivo of this class of drugs There have been reports of the use of antibiotics, including azithromycin reported.³⁰ A recent review of the literature and a meta-analysis review highlighted the fact that the frequency of SNHL compared to other antibiotics, macrolide exposure is higher. even in comparison to other antibiotics or a placebo regular doses of oral medication. It's the combination of drugs that makes it work. lopinavir–ritonavir (antiviral medication). included among the existing protease inhibitors .There are only a few reports on treatments for Covid 19. anecdotal cases of hearing loss linked to the disease were discussed postulating the possibility of mitochondrial dysfunction Toxicology as a possible cause.

Antiviral agent ribavirin is also known to have antiviral properties. if given in combination with interferon whether or not studies on the ototoxic potential of Ribavirin is hard to come by on its own.

Author, Year	Country	Type of Study	N	Age (years)	Sex	Otologic, Vestibular or Aural Symptoms	SSNHL Description	COVID Symptoms
Chern et al. 2020 [7]	United States	Case report	1	18	F	Bilateral SSNHL, intermittent bilateral aural fullness, vertigo	R: Pure-tone average of 60 dB, 88% word recognition score L: Pure-tone average of 63 dB, 80% word recognition score	Nausea, vomiting, loss of taste, and olfaction
Kilic et al. 2020 [18]	Turkey	Case series	1	29	M	Right-sided SSNHL	R: Profound high-frequency SSNHL L: No audiogram reported	Fever, cough, headache, myalgia
Lang et al. 2020 [9]	Ireland	Case report	1	30	F	Right-sided SSNHL, tinnitus	R: Profound high-frequency SSNHL L: No audiogram reported	Fever, cough, headache, myalgia
Koumpa et al. 2020 [19]	United Kingdom	Case report	1	45	M	Left-sided SSNHL, tinnitus	Weber test lateralized to the right, negative Rinne test R: No audiogram reported L: Pure tone audiogram - 2, 3, 4, and 6 kHz with hearing thresholds of 65, 75, 75, and 85 dB respectively	Asymptomatic
Karimi-Galougah et al. 2020 [8]	Iran	Letter to Editor	1	22	M	Left-sided SSNHL	L: Normal downsloping to severe SSNHL R: NR	Dyspnea, cough
Karimi-Galougah et al. 2020 [8]	Iran	Letter to Editor	1	40	F	Right-sided SSNHL, tinnitus	R: Moderate downsloping to severe SSNHL L: NR	Dyspnea, cough, malaise
Karimi-Galougah et al. 2020 [8]	Iran	Letter to Editor	1	23	F	Left-sided SSNHL, tinnitus, vertigo	R: NR L: Flat mild to moderate SSNHL	Dyspnea, cough

TABLE 1: Demographics and Clinical Manifestations of Patients With SSNHL and Confirmed COVID-19 Diagnosis

N: Number of patients; F: Female; M=Male; NR: Not reported; SSNHL: Sudden sensorineural hearing loss; L: Left; R: Right

Author, Year	Comorbidities	COVID-19 Treatment	SSNHL Treatment	Treatment Outcome
Chem et al. 2020 [7]	NR	None	Prednisone, Intratympanic dexamethasone injection, oral steroid	Near-resolution of vestibular symptoms; Significant improvement in balance
Koumpa et al. 2020 [20]	Asthma	Colecalciferol, doxazosin, fluticasone nasal spray, folic acid, lansoprazole, loratadine, ramipril, rivaroxaban, tadalafil, salbutamol inhaler	Prednisolone, Intratympanic methylprednisolone sodium succinate injection	R: No audiogram reported L: Pure tone audiogram - 2, 3, 4 and 6 kHz with hearing thresholds of 55, 60, 60 and 80 dB respectively
Lang et al. 2020 [9]	NR	None	Oral prednisolone	No improvement on audiological assessment a week after prednisolone treatment
Kilic et al. 2020 [18]	NR	Hydroxychloroquine	Prednisolone, vitamin B, folic acid complex, proton pump inhibitor	Complete resolution of hearing loss
Karimi-Galougah et al. 2020 [8]	NR	NR	NR	NR
Karimi-Galougah et al. 2020 [8]	NR	NR	NR	NR
Karimi-Galougah et al. 2020 [8]	NR	NR	NR	NR

TABLE 2: Treatment and Treatment Outcomes of Patients With SSNHL and Confirmed COVID-19 Diagnosis

N= Number of patients; F= Female, M=Male; NR = Not reported; SSNHL = Sudden sensorineural hearing loss; L: Left; R: Right

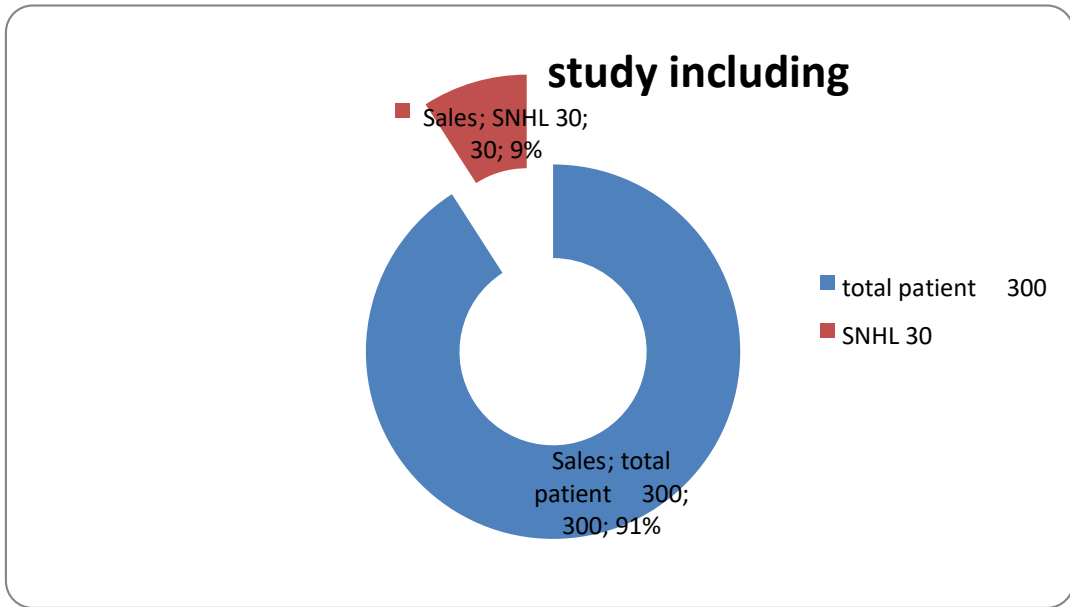


Figure 1. Study including

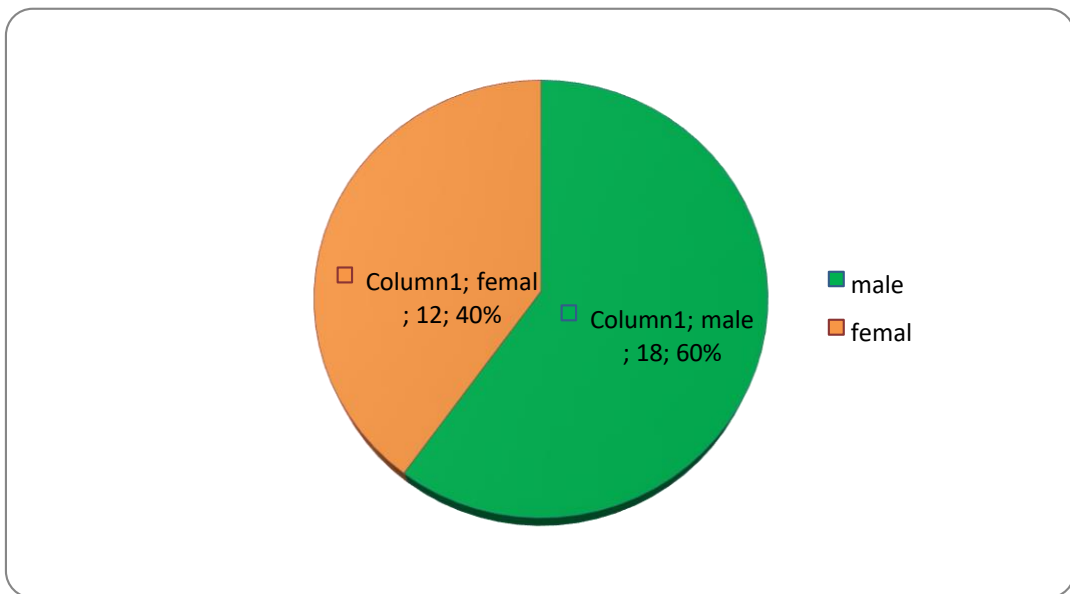


Figure 2. Male to female ratio

Table 3. Characteristics of patients

Characteristics	
AGE	(range 18–67 years).
mal female ratio	18 :12
hearing loss	30
tinnitus	7

ear pain	2
dizziness	3
peripheral facial nerve palsy	2
vertigo	5

Table 4. Treatment outcomes of 30 patients with COVID-19-related SSNHL.

Prognosis	no. of patients
recovered completely	2 patients (6.6%)
recovered partially,	17 patients (56.6%)
case improved slightly	1 patient (3.3%)
unknown	2 patient (6.6%)
not improve	7 (23.3%) patients did
recovered completely on one side and partially on the other, and	1 patient (3.3%)

Discussion

Tinnitus and/or vertigo have been linked to COVID-19 infection-induced sensorineural hearing loss (SNHL). A variety of theories have been put forth thus far proposed as an explanation for the etiopathogenesis of neurological symptoms observed during the acute and post-acute phases of infection. Many or a combination of factors may be at play. the etiopathogenesis of various symptoms, including those related to the nervous system SNHL. Hypoxia, immune-mediated damage, coagulative disorders, and other conditions may be present. directly infected with a virus and causing damage .An inner ear virus vulnerability has been reported, so direct damage is possible. hypothesized. COVID-19 patients have a high rate of chemosensory impairment, which supports this conclusion. olfactory nerves may represent SARS-neuro-invasiveness CoV-2's features. central nervous system entry point for the virus. Moreover, 25% of patients were also included in the study. According to the findings of this review, there was facial nerve disorder as well as taste and smell dysfunction. only 4.6% of the time is this a problem. In addition, the nervous system was directly involved in the process. revealed by an MRI of the brain that showed a significant increase in contrast to do with the 8th and 7th nerves SARS-CoV2 direct damage explanation mechanism proposed infected person's angiotensin-converting enzyme 2 receptor (ACE 2). It is a matter of fact. SARS-CoV2 binding partner in human cells, which is required for interaction with the virus. protein spikes of viral infection. ACE has been identified by a number of authors since the outbreak of the pandemic. Other tissues than the respiratory tract have well-documented receptors, a possible explanation for the extrapulmonary symptoms associated with COVID-19 The ACE2 receptors have been found in both animal models and humans' Eustachian tubes, middle ears, and hair cells in the cochlea Because these tissues are human, it is possible that the SARS-CoV-2 virus can infect them. [19] The hypothesis of direct hearing damage has been tested through the experimentation of the experiment. newborns who were exposed to SARS-CoV-2 while in the womb Nevertheless, There has been no conclusive evidence that congenital infection increases the risk of hearing loss established. Several studies have found that the vertical transmission of COVID-

19 is extremely low and that Until now, only one study has found a link between an increase in hearing loss an during pregnancy, SARS-CoV-2 positivity [3]; however, maternal infection appears to be a risk factor

It is linked to decreased fetal growth and increased mortality during pregnancy [3]. In addition, because the arterial supply to the cochlea is terminal, several intra- and Variations in vascularization, a microvascular disorder linked to the infection/inflammation. Hearing loss that is sudden, symmetrical, and one-sided can be caused by inflammation. An ischemic injury (Brain micro-hemorrhages [9] are also possible complications. By using brain MRIs, two patients with hearing loss were found to have a labyrinth [11]. obliteration (indirect hemorrhagic damage). When it comes to micro-vascular damage, the post-mortem examination is the most reliable source. COVID-19 patients' brainstems were found to be degenerated by histopathological examination. endothelial cells in the basal lamina, as well as perivascular congestion infiltration of macrophages and lymphocytes into the brain and spinal cord A number of authors have suggested that the SARS-CoV-2 virus could increase the amount autoimmunity could be triggered by proinflammatory cytokines. possibly contribute to the pathogenesis of Guillain-Barré and Susac syndrome. This connection, on the other hand, is still up for debate. When approaching patients with hearing loss, a correct diagnosis is necessary. misfortune, which may be connected to COVID-19 Establishing a clear link between the two events is essential. A confirmed SARS-CoV-2 infection (PCR for the rhino-pharyngeal) and the onset of SNHL The swab (as opposed to the reports included in this review), The overall incidence of sudden SSNHL has been found to decrease in very few studies. likely caused by medical masks being worn by many people during the COVID-19 pandemic in relation to social exclusion. There's a chance that these factors helped keep other Viruses and, possibly, the emergence of new cases of SSNHL. Then there's the fact that it has it has been reported that patients may have delayed or avoided treatment because of the lockdown periods healthcare, particularly for conditions that are not lifethreatening, and thus SSNHL cases may They have been undervalued. Unfortunately, a comprehensive audiological examination is not possible. isolation and intensive-care unit-admitted patients infected and isolated (ICU), SNHL is often misdiagnosed, which delays the onset of symptoms. adequate medical care, as shown in certain examples, can have a significant impact on the course of events: There is only a 12.5 percent chance of a full recovery for SNHL in this study. Prevention plans will be developed in accordance with the reports currently available is a challenge. The literature suggests that COVID-19 may be linked to some incidences of The beginning of hearing loss. A timely diagnosis and treatment are critical in many circumstances. The need of timely therapeutic intervention cannot be overstated. It is estimated that there are 6,000 new cases of SSNHL per year in the United States. It's essential to remember Recognize, however, that SSNHL is not only caused by a COVID-19 viral etiology or a viral infection. Toxicity in the form of medication Prior to the COVID-19 pandemic, Chari et al. conducted research between March 15 and May 31, 2019 Out of 4013 probable instances, a total of 71 cases of SSNHL were identified, according to the study by et al (1.77 percent). As part of the COVID, From March 15, 2020 to May 31, 2020, there were 13 confirmed SSNHL cases out of 681 people tested. cases that are under investigation (1.91 percent). Negative for SSNHL was discovered in none of these 13 individuals. [22] COVID-19 SSNHL is likely complex, and whether or not COVID-19 has an effect on it should be recognized. These factors have not been studied to see if they have an impact.. Patients in our research SSNHL and other symptoms, such as tinnitus, vertigo, and auditory fullness, were also noted.

Additionally, A diagnosis of intralabyrinthine hemorrhage was made using MRI in one of the patients [7]. Interestingly, Patients in our study had SSNHL at varied stages of their illness. By contrast, in Kilic et al. SSNHL was the patient's sole COVID-19 symptom [18]. The otologic symptoms were described by Chern et al. [7] COVID-19-related anosmia and ageusia were first, with a delayed onset. [20] Symptoms When other COVID-19 symptoms were resolved, SSNHL emerged in Lang et al.. In In the case of COVID-19, the patient had a complex course that required intubation, which resulted in the patient's death. pulmonary hypertension, bilateral pulmonary emboli, and anemia are all symptoms of ventilator-associated pneumonia. He One week after extubation, SSNHL and tinnitus were noticed [19]. An atypical diagnosis can lead to a delay in treatment Presentations like the ones reported are problematic because they have been linked to permanent hearing loss. poor health and quality of life outcomes Permanent hearing loss has been documented in the literature. depression and cognitive impairment are strongly linked to Alzheimer's disease.

Conclusions

COVID-19 is currently being presented in a variety of ways. Only a small percentage of patients suffer from Infection with COVID-19 and SSNHL may occur in the same patient, but the symptoms and prognosis may differ. Still, very little is known about the inner ear's potential causes. participation of the newly infected COVID-19 and among the many potential causes is of the inner ear disorders that are associated. As of right now, Only a small amount of literature is available concentrating on this issue and utilizing primarily case studies; SNHL, tinnitus, and dizziness, on the other hand, should be potential manifestations that could occur between the symptoms of this disease. The ototoxicity risk is also a consideration. used in conjunction with the treatment of some medical conditions it is necessary to treat the COVID-19 infection Monitor the use of these medications closely because they can cause hearing loss, vertigo, and tinnitus irreversible.

Recommendations

According to current data, covid 19 may have an adverse effect on cochlear function. Further research is needed, however, due to the limited number of reports available, many of which are anecdotal. To examine the possible etiopathological differences between covid 19 and covid 19 and SSNHL as well. But it is possible that SNHL is one of the manifestations of the disease. "Long COVID" syndrome, as the name suggests.

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