

Tinnitus in COVID-19 Patients; a Case Study

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Authors

Javanbakht M.¹ PhD,
Babae S.*¹ MSc

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ABSTRACT

Aims Due to the widespread prevalence of COVID-19, clinicians should be aware of even the rare symptoms of the disease to help the patients with the proper clinical procedure. In this study, a new case related to COVID-19 induced tinnitus was reported.

Patient & Methods The patient was 27 years old with a chief complaint of a sudden transient change in her chronic vascular tinnitus (loud pulsatile tinnitus) repeated several times a day during the illness period. Because the other symptoms were similar to those of COVID-19, she was referred for a PCR test.

Findings The PCR test for Covid19 was positive. Audiology examinations revealed intact tympanic membrane and normal hearing levels. Impedance audiometry and acoustic reflexes were standard. Tinnitus evaluations confirmed a change of tinnitus quality to higher pitch tinnitus with a louder loudness. HRCT scan did not show lung involvement.

Conclusion In our case, tinnitus change is possibly due to a change in the blood flow caused by vasculitis, a confirmed manifestation of viral infectious including Coronavirus. Patients with sudden audio-vestibular symptoms should be further evaluated for the COVID-19 rule out. More detailed investigations are required to determine the involved mechanisms.

Keywords Coronavirus; COVID-19; Tinnitus; Hearing

¹Department of Audiology, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

*Correspondence

Address: Department of Audiology, University of Social Welfare and Rehabilitation Sciences, Koodakyar Avenue, Daneshjoo Boulevard, Velenjak, Tehran, Iran. Postal Code: 1985713831.

Phone: +98 (21) 22180100

Fax: +98 (21) 22180066

samarbabaee_a72@yahoo.com

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Introduction

COVID-19 is an infectious disease caused by the newly discovered Coronavirus, a global pandemic in 2020 [1]. Fever, dry cough, and shortness of breath are the most common symptoms in COVID-19 patients. Some other symptoms are reported, such as chills, myalgia, headache, fatigue, loss of taste and smell, and gastrointestinal symptoms [2, 3]. Some cases of confirmed PCR test for Covid19 did not have typical symptoms of COVID-19, or the first sign of the disease was something other than the typical ones [4]. Audio-vestibular symptoms, including sudden hearing loss and tinnitus, are these rare symptoms [5].

To date, several possible mechanisms have been proposed to explain the audio-vestibular symptoms caused by COVID-19. Antiviral treatments involve both the peripheral and central auditory systems through inflammatory means, hematogenous track, and ototoxicity [6].

It is necessary to be up-to-date about the latest symptoms of the disease, even the rare ones, to help the patients with the proper clinical procedures. In this study, while reviewing the previous case reports, we reported a new case of tinnitus associated with COVID-19. In this case, tinnitus features differ from those reported in previous case studies. In this case, the first sign of the illness was a transient change in the quality of the chronic vascular tinnitus.

Previous studies are divided into three categories: 1. Case reports related to the patients with tinnitus during the illness 2. Case reports about the patients with post-recovery tinnitus and 3. Studies that investigated the prevalence of audio-vestibular symptoms, including tinnitus caused by COVID-19.

There is no history of hearing loss or ear pathology in any reports, and no ototoxic drugs were used.

-Prevalence of tinnitus caused by COVID-19: This section summarizes studies that examined the prevalence of audio-vestibular symptoms among the COVID-19 sufferers.

Iqbal *et al.* investigated 158 improved cases. Results revealed that 19% of individuals complained of tinnitus [7]. Also, Munro *et al.* examined 138 patients with COVID-19. The hearing of eight patients deteriorated which four of whom had a prior hearing loss. Also, eight patients reported tinnitus, with three had pre-existing hearing loss. One case reported hearing loss with simultaneous vertigo, and another individual had tinnitus and aural pressure [8]. The study carried out by Viola *et al.* evaluated a sample of 189 COVID-19 patients. Thirty-two patients experienced dizziness, and two patients suffered acute vertigo attacks. There were 43 reported patients with only tinnitus, and 14 patients reported both tinnitus and dizziness simultaneously, which shows the high rate of

tinnitus complaint among auditory symptoms [5].

-Tinnitus sufferers during the illness: Rhman *et al.* reported a 52-years-old male noticed a sudden left-sided hearing loss, which was preceded by worsening tinnitus. The audiology examination revealed a severe sensorineural hearing loss for the left ear. After intra-tympanic injection of corticosteroid, hearing levels improved. No data is reported regarding how treatment affects tinnitus [9]. Another similar case report was published by Chirakkal *et al.* about a 35-years-old female who complained of tinnitus and hearing loss in the left ear. Audiology evaluations were regular in the right ear. On the left side, a low-frequency hearing loss was noticed in the PTA test. Tympanometry was A-type, but acoustic reflexes were absent. TEOAE and DPOAE were absent in low frequencies. Tinnitus evaluation revealed a frequency and intensity matching of 4 kHz at 10 dB. There has been no information provided regarding the treatment of tinnitus and hearing loss [10].

-Post-recovery tinnitus patients: Lang *et al.* reported a 30-years-old female, 21 days after all her symptoms had resolved, eventually developed tinnitus and hearing loss on the right side. A PTA test revealed a profound high-frequency SNHL. MRI findings were normal. A trial of oral steroids was carried out, but there was no improvement [11]. Also, Koumpa *et al.* reported that a 45-years-old patient noticed tinnitus and sudden hearing loss in his left ear two weeks after discharge from ICU. On audiology examination, sensorineural hearing loss was observed in the left ear. Pure tone audiometry thresholds improved after intratympanic steroid injection. There is no information available concerning the effectiveness of injections for tinnitus [12]. Another similar case was reported by Lamounier *et al.* A 67-years-old female experienced a hearing loss and disabling tinnitus in the right ear after extubation. The audiometry revealed a severe sensorineural hearing loss in the right ear and mild SNHL in 4 and 8 kHz frequencies in the left ear. Tympanometry results showed type A on both sides, but contralateral reflexes were absent. After corticosteroid therapy, only the threshold of 250 Hz in the right ear was improved, while in the left ear, the thresholds of 4, 6, and 8 kHz were enhanced. However, the patient continued to complain of tinnitus [13].

The two last cases were hospitalized in the ICU due to the severity of the symptoms, while the first case was self-isolated at home. There are few studies on audio-vestibular symptoms caused by COVID-19, which may be due to two reasons: These symptoms are infrequent, and also, since this condition is not life-threatening, it receives less attention. In previous studies, the psychoacoustic properties or details of tinnitus have not been thoroughly

investigated, and most studies only examined whether hearing loss is accompanied by tinnitus or not. In this study, a new case related to COVID-19 induced tinnitus was reported.

Patient and Methods

In this case report, a 27 years old female audiologist with a chief complaint of a sudden change in her tinnitus referred to Asma Rehabilitation Center, Tehran, Iran, on April 10, 2021. She declared close contact with a confirmed COVID-19 case. In the past, this patient had been referred to Asma Rehabilitation Center with a complaint of vascular tinnitus, which had become chronic. Based on previous examinations, the patient had loud pulsatile tinnitus in the left ear, which corresponded perfectly with her pulse. Her last analyses by Audiologist, ENT specialist, cardiologist, and neurologist revealed idiopathic tinnitus and ruled out any specific disease. According to the patient report, about seven days before this new visit, her tinnitus suddenly changed to a louder sound with a higher pitch than its previous state for about two minutes. The new tinnitus has wholly masked the previous tinnitus (chronic pulsatile tinnitus). This condition happened several times a day. 2 days after the first experience of tinnitus change, the patient had mild cold symptoms (sore throat and drowsiness), which improved after three days, and in the following days, a dry cough, chest pain, and shortness of breath appeared during physical activity. Due to the similarity of the other symptoms to those of COVID-19, she was referred to an infectious disease specialist for further examination.

Findings

Otoscopic examination revealed an intact external ear canal and tympanic membrane on both sides. The audiometry test results were typical. Tympanometry was type A (Figure 1), and acoustic reflexes were present. Because the new tinnitus was of short duration (about 2 minutes), the psychoacoustic evaluation was done in more than one stage; during one single session, the evaluation steps (Quality, Pitch matching test, Loudness matching test, Minimum masking level, Residual inhibition, VAS) were performed in time that new tinnitus occurred.

Table 1 summarizes the psychoacoustic characteristics of the previously and newly experienced tinnitus. According to this table, the new tinnitus was louder, tonal tinnitus with a higher pitch.

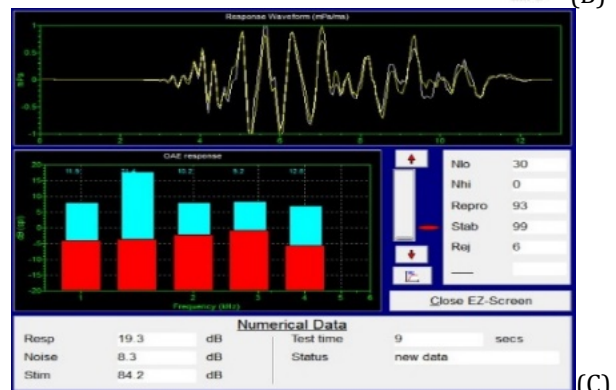
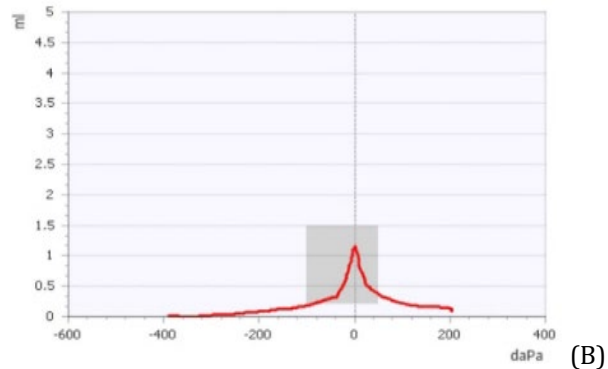
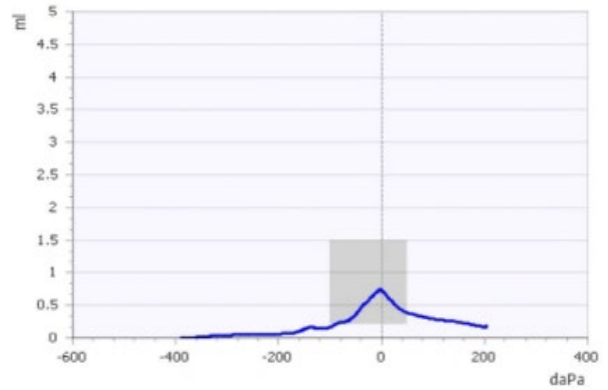
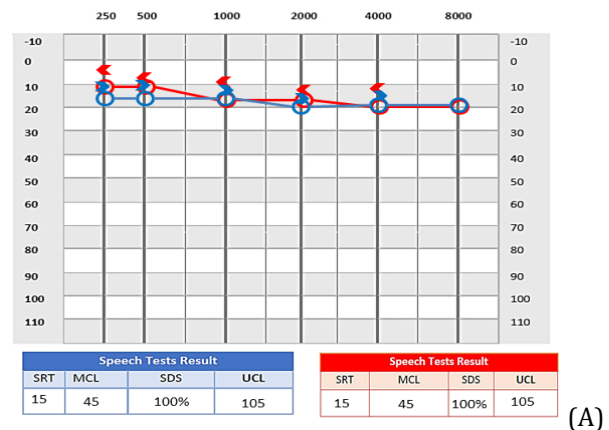
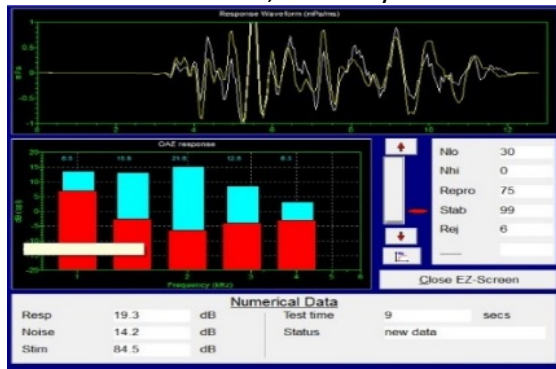
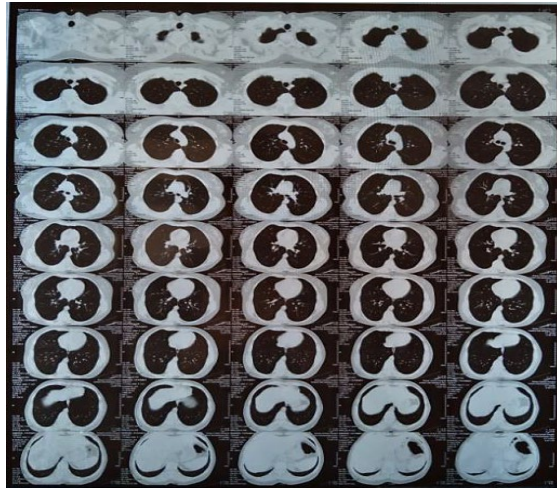


Figure 1) A: pure tone audiometry results. B: tympanometry results with type *An* in both ears. C: TEOAE results. D: HRCT scans of the lungs. Audiology test results of both ears were within normal limits. There was no sign of lung involvement in the HRCT scans of the lungs despite clinical picture and PCR positive to Covid19.



(C)



(D)

continue of Figure 1) A: pure tone audiometry results. B: tympanometry results with type *An* in both ears. C: TEOAE results. D: HRCT scans of the lungs. Audiology test results of both ears were within normal limits. There was no sign of lung involvement in the HRCT scans of the lungs despite clinical picture and PCR positive to Covid19.

Table 1) The psychoacoustic characteristics of the previously and newly experienced tinnitus

Characteristics	Previously experienced tinnitus	New tinnitus
Quality	Noisy, pulsatile	Tonal, constant
Pitch matching test	125 Hz	750 Hz
Loudness matching test	3 dB SL	7 dB SL
Minimum masking level	No mask ability	No mask ability
Residual inhibition	Negative	Negative
VAS (Visual Analogue Scale)	2/10	8/10

The High-Resolution Computerized Tomography scan (HRCT scan) did not show lung involvement, but the PCR test was positive for Covid19. In the follow-up, the researcher noticed that she had experienced the sudden transient change in tinnitus several times a day until the end of the full recovery of her illness. About 16 days after her first exposure to the Coronavirus, her symptoms have disappeared, and the tinnitus has ultimately returned to its previous state.

Discussion

COVID-19 may result in hearing loss and tinnitus due to various mechanisms [6], but direct damage of

OHCs of the cochlea is generally the most considered mechanism in agreement with Mustafa et al. report [4]. The lack of careful study of tinnitus in cases not associated with hearing loss is why other mechanisms have not been considered. In this study, we reported a case that illustrates the point.

In the case reported here, the first sign of the COVID-19 disease was a transient change in the psychoacoustic characteristics of chronic vascular/pulsatile tinnitus in a young female patient that was repeated temporarily several times a day just during her illness period. In this case, tinnitus was not associated with hearing loss. There are two possible explanations about this case: Maybe COVID-19 caused a new higher pitch and louder tinnitus, so the previous tinnitus became inaudible, or maybe The psychoacoustic characteristics of previous tinnitus have been changed into a louder and higher pitch tinnitus.

Pasquale Viola *et al.* showed that in 23.2% of the patients, tinnitus was the only audio-vestibular symptom caused by COVID-19 [5]. Further, this study found that the incidence of tinnitus in terms of its frequency of occurrence could be categorized as follows (in order of prevalence): recurrent, occasional, continuous floating, persistent, pulsatile, and ongoing. In our case, tinnitus was the only audio-vestibular sign which was repeated several times a day. So it can be classified as recurrent tinnitus.

Tinnitus in patients with COVID-19 cannot be definitively linked to a specific mechanism because no comprehensive pathophysiologic study has been conducted. Vasculitis is considered to cause audio-vestibular symptoms due to the sensitivity of the inner ear structures to the blood flow [14]. Vasculitis is a clinical manifestation of several viral infections, including Coronavirus [15]. Accordingly, in the presented case, the COVID-19 did cause a change in vascular tinnitus, which may have been caused by the effects of vasculitis.

Further studies are needed to determine the psychoacoustic characteristics and the causes of tinnitus induced by COVID-19. In similar cases, it is recommended that it is better to refer the patient for a PCR test or comprehensive examination to consider treatment protocols on time and prevent the spread of the virus.

Conclusion

Rarely, COVID-19 can cause audio-vestibular symptoms, including tinnitus. So it should be considered to refer the patients with a sudden tinnitus change for a PCR test. Further studies are needed to determine the cause of tinnitus change induced by COVID-19.

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