A 67-Year-Old Woman with Sudden Hearing Loss Associated with SARS-CoV-2 Infection

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Patient: Female, 67-year-old
Final Diagnosis: SARS-CoV-2
Symptoms: Cough • fever • hearing Loss
Medication: —
Clinical Procedure: Intensive Care Unit (ICU)
Specialty: Otolaryngology

Objective: Unusual clinical course
Background: Few reports have described the association between coronavirus disease 2019 (COVID-19) and sudden hearing loss. The precise pathophysiological mechanism causing this symptom is unknown. This report describes a case of sudden hearing loss in a patient with COVID-19 pneumonia due to SARS-CoV-2 infection.

Case Report: A 67-year-old woman with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), as confirmed by reverse transcription-polymerase chain reaction (RT-PCR) testing from nasopharyngeal and oropharyngeal swabs, was examined. She experienced sudden hearing loss in her right ear and disabling tinnitus. She underwent combined corticosteroid therapy (oral and intratympanic), resulting in an isolated improvement of 250 kHz in the right ear (from 60 dB, the threshold became 15 dB) and of 4, 6, and 8 kHz in the left ear (from 35 dB, 20 dB, and 35 dB, the thresholds became 15 dB, 5 dB and 20 dB, respectively).

Conclusions: Although rare, hearing loss appears to be a possible sequela to SARS-CoV-2 infection and deserves attention because it is a medical emergency requiring immediate clinical treatment. Additional studies are needed to assess the pathophysiological mechanisms involved in and the long-term characteristics of this type of hearing loss.

MeSH Keywords: COVID-19 • Hearing Loss • Audiometry • Tinnitus • SARS Virus • Deafness

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Background

The virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is responsible for the current pandemic, causes coronavirus disease 2019 (COVID-19). Its main symptoms are fever, fatigue, and a dry cough, which may progress to dyspnea or, in more severe cases, to SARS [1]. Other reported symptoms include headache, myalgia, odynophagia, nasal obstruction, runny nose, anosmia, dysgeusia, and gastrointestinal manifestations.

On March 11, 2020, COVID-19 was characterized by the World Health Organization as a pandemic disease [2]. Within weeks, the virus spread to more than 200 countries. In Brazil, the first confirmed case of COVID-19 was reported in the city of São Paulo, on February 26, 2020. In Goiânia, the first positive tests were reported on March 12. Worldwide, 25 118 883 cases of COVID-19 and 844 298 deaths were confirmed as of August 31, 2020. In Brazil, 3 846 153 cases were confirmed [2].

Little information is available in the literature on the relationship between COVID-19 and sudden hearing loss. We performed a systematic search using the keywords “hearing loss”, “sudden hearing loss”, and “COVID-19” in the PubMed, Lilacs, MEDLINE, Clinical Trials, Cochrane, Open Grey, and Google Scholar databases through August 6, 2020. Only 7 studies that included reports of patients with hearing loss and COVID-19 were identified. One article [3] reported a case of sudden hearing loss in an elderly woman from Thailand. Another article from Iran [4] presented 6 cases of patients with sudden hearing loss and a clinical suspicion of COVID-19, but only 3 had a laboratory confirmation of infection. Another report from Turkey [5] described an asymptomatic man who presented with only sudden hearing loss, and COVID-19 was confirmed through reverse transcription-polymerase chain reaction (RT-PCR) testing during the etiological investigation. A fourth article from Japan [6] described a 73-year-old man who experienced sudden hearing loss. Seven days after the beginning of treatment with systemic corticosteroid therapy, he experienced typical manifestations of COVID-19 and tested positive for the disease. A fifth article from Germany [7] described a previously healthy 60-year-old man who experienced asymmetric and bilateral sudden hearing loss and tinnitus after being discharged from an Intensive Care Unit (ICU), where he was confirmed to have SARS-CoV-2 infection through RT-PCR from a nasopharyngeal swab.

A sixth article from China [8] reported a 38-year-old man who experienced bilateral hearing loss and tinnitus for 2 months. He underwent endoscopic tympanometry, and after 2 days, he experienced clinical manifestations of COVID-19 and received laboratory confirmation through RT-PCR from sputum. Finally, a seventh article from Turkey [9] reported the association between acute otitis media in a 35-year-old female patient with previously undefined otalgia, tinnitus, and conductive hearing loss who was diagnosed with COVID-19 from physical examination results, RT-PCR testing, and radiographic studies.

This report describes a case of sudden hearing loss in a 67-year-old woman with COVID-19 pneumonia due to SARS-CoV-2 infection.

Case Report

The patient, a 67-year-old Brazilian woman and resident of Goiânia, Goiás (Brazil), has rheumatoid arthritis and has been using 400 mg of hydroxychloroquine per day for 4 years. She denies a history of diabetes mellitus, high blood pressure, smoking, or alcohol consumption.

She traveled to Italy on February 22, 2020, and returned to Brazil on March 12. On this day, the patient and 3 other colleagues who traveled with her experienced unverified fever, a dry cough, and malaise. Because of her feverish state and recent travel, the patient underwent a reverse transcription-quantitative polymerase chain reaction (RT-qPCR) test for COVID-19 (Biopur®) using nasopharyngeal and oropharyngeal swabs (XGEN Master), which was collected on March 13.

She presented to the emergency room on March 15, 2020, and was hospitalized with fever, chills, and nausea. On March 16, 2020, the diagnosis of COVID-19 was confirmed by the results of the RT-qPCR test of March 13.

She underwent chest computed tomography (CT) on March 16, which showed extensive “ground-glass” opacities and consolidations involving more than 75% of the lung volume. Oseltamivir was started on March 15 and was administered for 11 days. Enoxaparin was started on March 17 and was administered throughout her hospital stay.

On March 18, she was transferred to the ICU because of respiratory failure and was diagnosed with SARS. She was then started on azithromycin and piperacillin with tazobactam, which was administered for 7 days. The patient remained on mechanical ventilation for 3 weeks, presenting with septic shock with a pulmonary focus. On March 24, she was started on meropenem, which was administered for 14 days. She underwent a chest CT scan on April 14, which showed radiological improvement.

Soon after being extubated and regaining consciousness, the patient noticed hearing loss in her right ear. She progressed well from a clinical perspective, and was discharged from the ICU on April 9, 2020. She was finally discharged from the hospital 34 days after her admission, on April 9, 2020. She was finally discharged from the hospital 34 days after her admission, on April 17, 2020. This patient and her 3 colleagues are considered the index cases of Goiânia, Goiás.
Prior to this event, the patient denied a history of any otological complaints. She had previously undergone audiometry on August 27, 2019, showing isolated hearing loss at the frequencies of 6 and 8 kHz in the right ear (thresholds were 45 dB and 30 dB, respectively) and thresholds within the normal range in the left ear (Figure 1).

Based on the audiological findings, she was evaluated by an otolaryngologist on May 5, 2020. She presented normal otoscopic findings, without any changes. She reported disabling tinnitus, and audiometry showed severe sensorineural hearing loss in the right ear, in addition to isolated hearing loss in the frequencies of 4 and 8 kHz in the left ear (the thresholds were 35 dB at both frequencies) (Figure 2). Impedance testing

Figure 1. The patient’s previous audiometry scan conducted in August 2019, showing isolated hearing loss at the frequencies of 6 and 8 kHz in the right ear (thresholds were 45 dB and 30 dB, respectively) and thresholds within the normal range in the left ear.

Figure 2. The audiometry scan performed on May 5, 2020, after the patient presented with sudden hearing loss, showing severe sensorineural hearing loss in the right ear and isolated hearing loss at the frequencies of 4 and 8 kHz in the left ear (the thresholds were 35 dB at both frequencies).
showed a bilateral type A curve, and no bilateral contralateral stapedial acoustic reflexes were observed.

Combined corticosteroid therapy was then prescribed (oral and intratympanic). For the oral therapy, prednisolone was administered at decreasing doses (60 mg for 7 days, 40 mg for 7 days, 20 mg for 5 days, and 10 mg for 5 days). This treatment was combined with intratympanic applications of corticosteroids in the right ear after topical anesthesia with a 2% tetracaine spray in the ear canal and 44% phenol on the eardrum at the site of application. The 4 mg/mL dexamethasone solution was heated, and then an intratympanic application of 0.4 to 0.7 mL per session was performed for a total of 5 sessions. Because a concentration of dexamethasone higher than the 4 mg/mL formulation is not available in Brazil, the interval between intratympanic applications was subsequently reduced to 3 days. During corticosteroid therapy, the patient’s blood pressure increased, but then normalized after the end of oral corticosteroid use. She did not report any other adverse effects.

For diagnostic imaging test a brain magnetic resonance imaging was performed on May 20, 2020 (Figure 3), showing multiple isolated microhemorrhagic lesions more numerous in the splenium of the corpus callosum and more discrete in the cerebellum, medium cerebellar peduncles and subcortical white matter.
isolated microhemorrhagic lesions, which were more numerous in splenium of the corpus callosum and more discrete in the cerebellum, medium cerebellar peduncles, and subcortical white matter. No signs of ischemic injuries or changes in the auditory canal were observed. Magnetic resonance angiography of the brain and neck showed no changes.

The patient subsequently underwent audiometry again on June 23, 2020, with an isolated improvement of 250 kHz in the right ear (from 60 dB, the threshold became 15 dB) and of 4, 6, and 8 kHz in the left ear (the thresholds became 15 dB, 5 dB, and 20 dB, respectively) (Figure 4), but the patient still complained of tinnitus.

**Discussion**

Sudden hearing loss is classified as a medical emergency because of the discomfort it causes the patient and the need for immediate treatment. Hearing loss has been defined as a sensorineural hearing loss of at least 30 dB for 3 consecutive frequencies that occurred over a period of less than 72 hours [10]. Due to the substantial psychological burden of the hearing loss and the disabling tinnitus presented by our patient, we opted for initial joint therapy with oral and intratympanic corticotherapy.

In addition to the present case report, there are other similar reports in the literature that reinforce the association between COVID-19 and audiological changes. There is a case report from Thailand describing an elderly woman with COVID-19 who presented with sensorineural hearing loss [3], which is similar to the epidemiological profile of the patient in our report.

A study from Iran [4] also reported 6 patients with clinical and epidemiological features suggestive of COVID-19; however, only 3 patients underwent RT-PCR testing and received laboratory confirmation of SARS-CoV-2. The patients had acute-onset unilateral sensorineural hearing loss, as was the case in our patient. These patients, however, were younger (aged between 22 and 40 years) and did not have comorbidities, and there were no reports of ototoxic drug use. Of these patients, 2 had vertigo and 4 had tinnitus, a symptom also demonstrated by our patient.

There is also an article from Germany [7] that presents the case of a previously healthy 60-year-old male patient with a chronological evolution very similar to that of the patient in our report. The patient remained in the ICU for 13 days because of COVID-19 respiratory complications (confirmed by RT-PCR from a nasopharyngeal swab), and after consciousness was recovered, he developed bilateral hearing loss and tinnitus. He had profound sensorineural hearing loss in the left ear and anacusis in the right. This patient was treated with 3 intratympanic triamcinolone injections and a cochlear implant.

An article from Japan [6] reports the case of a 73-year-old man who presented with sudden deafness and was medicated with oral corticotherapy. After 7 days of treatment, he developed severe respiratory symptoms and was diagnosed with COVID-19 through sputum PCR testing.

An article from Turkey [5] reports that 5 patients aged between 29 and 54 years old who had sudden deafness as their only symptom. They denied comorbidities or use of ototoxic medication. All underwent RT-PCR testing from nasopharyngeal and oropharyngeal swabs, but only 1 patient had laboratory confirmation of COVID-19.

Three possible pathophysiological mechanisms for sudden hearing loss are classically described: a microcirculatory disorder, inapparent viral infection, and a localized immune process [11]. Our patient had an autoimmune disease and presented with a severe viral infection with probable mechanisms of aggression to the microcirculation.

Although both ears are similarly vulnerable to sudden deafness, most patients with hearing loss present unilateral impairment. Simultaneous bilateral or second ear involvement is very rare, and in these cases, clinicians should focus on ototoxicity as one of the main causes [10]. Since our patient’s hearing loss was unilateral, ototoxicity was unlikely the probable etiology. Hydroxychloroquine has been reported to cause possible, albeit rare, ototoxicity. However, the patient described in the present case was already taking this medication chronically to treat rheumatoid arthritis, and she had normal hearing thresholds on previous exams. During hospitalization, other drugs known to be ototoxic were not administered.

Another possibility that must be considered is hearing loss induced by noise or acoustic trauma during her ICU stay. However, the audiometry findings presented here were not consistent with the changes that would classically be expected in those cases.

The multiple microhemorrhagic lesions in her white matter on magnetic resonance imaging have also been observed in 9 (25%) of 37 patients with a severe clinical presentation of COVID-19 and neurological changes in a study involving several institutions conducted in France [12].

Notably, the patient in this case report presented with several characteristics considered to indicate a poor prognosis for sudden deafness, including female sex, age over 60 years, severe hearing loss, poor vocal discrimination, and audiometry with a flat curve. Nevertheless, after 30 days of treatment, she began to show improvements in her hearing thresholds.
Many hypotheses have been proposed about the pathophysiology of COVID-19 and the mechanisms that may result in atypical manifestations of the disease [13–16]. Possible etiologies include an impairment in the auditory center in the temporal lobe due to viral pathophysiology mediated by angiotensin-converting enzyme 2 (ACE2), the involvement of the microvasculature of the inner ear or the auditory center, or a peripheral injury (to the hair cells of the cochlea) due to the neurotropism of this virus [13–15].

According to the theory of viral adhesion to ACE2, a potential cause of neurological involvement is the overexpression of this protein in the brain. If the auditory center in the temporal lobe is damaged, hearing loss may occur [13].

Another hypothesis is the occurrence of changes in the microvasculature secondary to COVID-19, either caused by thrombi or emboli, which might produce ischemic lesions in the inner ear or the auditory center [13]. SARS-CoV-2 infection has been associated with various thrombosis-related complications, both venous and arterial, leading to a systemic multigang condition. This virus appears to cause endothelitis in the hearing center of the temporal lobe, the cochlear nerve, and tissues of the cochlea [15].

A COVID-19-induced decrease in the concentration of oxygen in erythrocytes has also been proposed, which might culminate in cellular hypoxia of the centers responsible for hearing [13].

Damage to the auditory system secondary to viral infections is typically intracochlear damage; however, some viruses also affect the auditory brainstem. Mechanisms of injury to the peripheral auditory system may include direct viral damage to the organ of Corti, stria vascularis, or spiral ganglion [14].

A recent study in Egypt [14] compared 20 asymptomatic patients with COVID-19 (confirmed through viral RNA testing of throat swabs) with an age-matched control group of patients. The high-frequency pure tone thresholds (4000, 6000, and 8000 Hz) and the amplitudes of transient otoacoustic emissions were significantly worse in the test group. The authors showed that COVID-19 infection exerted deleterious effects on cochlear hair cells, confirming that the auditory symptoms caused by the COVID-19 virus may become increasingly prevalent.

Therefore, it is important to highlight hearing loss as a possible symptom within the complex clinical picture of COVID-19 [16]. Hearing loss has a major impact on quality of life, especially after a serious illness. The early detection of this symptom allows the initiation of drug therapies and hearing rehabilitation, enabling patients to return to normal life more quickly.

A limitation of this case report was the limited number of published studies in the literature, particularly studies examining the pathophysiological mechanisms of COVID-19. The best explanation of the pathophysiology of aggression by SARS-CoV-2 may indicate new lines of treatment for the sequelae caused by the disease, including hearing loss.

Conclusions

This case reaffirms the importance of reporting sudden hearing loss associated with COVID-19. Audiological monitoring is recommended in such cases, and early treatment should be initiated in patients presenting with this symptom.

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