

Clinical Record

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Sudden hearing loss and coronavirus disease 2019: the role of corticosteroid intra-tympanic injection in hearing improvement

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Abstract

Background. Coronavirus disease 2019 was first seen in December 2019. Due to the insidious and complex nature of the disease, the list of symptoms is rapidly expanding. So far, few studies have reported sudden sensorineural hearing loss as a possible symptom of coronavirus disease 2019.

Case report. A 60-year-old woman with a complaint of sudden sensorineural hearing loss and subjective severe tinnitus presented to the ENT clinic. Coronavirus disease 2019 was subsequently confirmed with a polymerase chain reaction test. At the time of presentation, she was treated with intra-tympanic dexamethasone. Improvements in hearing threshold and speech perception, and a subjective reduction in tinnitus, were observed after treatment.

Conclusion. This case report supports evidence from other case reports of a possible association between coronavirus disease 2019 and sudden sensorineural hearing loss. Sudden sensorineural hearing loss may be a symptom of this disease that behaves as an underlying aggravating factor. Intra-tympanic injection of corticosteroids is recommended for managing these patients during the pandemic.

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), responsible for coronavirus disease 2019 (Covid-19), was first seen in Wuhan, China, in December 2019, and developed into an outbreak worldwide.¹ Given the rapid emergence of this disease, there are many unknowns about its pathogenetic effects on various organs, and its symptoms, diagnosis and treatment.^{1–3}

The most common symptoms of this disease are fever, cough, fatigue and difficulty breathing. In a smaller number of infected people, headache, confusion, gastrointestinal symptoms and nausea have also been reported.⁴ Furthermore, anosmia is now associated with Covid-19.⁵ Most patients with Covid-19 show mild to moderate symptoms; however, about 15 per cent develop severe pneumonia, and 5 per cent develop acute respiratory distress syndrome, which eventually leads to shock and multiple organ failure.^{1–3} In addition to causing acute respiratory syndrome, the disease triggers a cytokine storm and activates immune responses. However, uncontrolled inflammatory responses and impaired immune responses can lead to local and systemic tissue damage.³

Research is ongoing into the effects of the virus on other organs in the body. One of these organs is the auditory system. Multiple viral infections can cause sudden sensorineural hearing loss (SNHL). Sudden SNHL is determined as 30 dB or more SNHL occurring in at least three successive frequencies over 72 hours.⁵ A range of aetiological risk factors have been suggested as causes of sudden SNHL, including viral infection, vascular impairment, autoimmune disease, inner-ear pathology and central nervous system anomalies. In most cases, sudden SNHL occurs because of a viral infection.⁶ Hearing loss caused by these factors can be unilateral or bilateral. This paper reports a sudden SNHL patient who tested positive for Covid-19, and it describes her treatment. We also review previous relevant reports.

Case report

On 12 July 2020, a 60-year-old woman presented to an ENT clinic with sudden hearing loss and subjective tinnitus in her left ear. This patient had a history of previous visits to the clinic and her previous audiometric results showed a mild hearing loss on both sides that could have been age-related (Table 1). Her complaint was unilateral sudden hearing loss in her left ear with severe tinnitus in the same ear that started 2 days earlier. She had no history of ear pain or discharge, dizziness, vertigo, head trauma, ototoxic medications, or upper respiratory tract infection.

Otological assessment, including otoscopic examination, showed bilaterally normal external auditory canals and opaque tympanic membranes. Tuning fork tests revealed

Table 1. Pure tone audiometry, speech audiometry and tinnitus loudness in Covid-19 positive patient at each treatment stage

Ear	AC/BC audiometric threshold (dB HL) by frequency						Pure tone average (dB) 0.5, 1 & 2 kHz	Speech audiometry		Tinnitus loudness score
	0.25 kHz	0.5 kHz	1 kHz	2 kHz	4 kHz	8 kHz		SRT (dB)	SDS (%)	
Right										
- Baseline	30/25	25/25	30/30	35/30	35/35	40/40	30	30	100	-
Left										
- Baseline	30/30	35/35	35/30	40/40	40/35	40/40	36.6	35		-
- After sudden HL & before treatment	90/NR	100/NR	105/NR	80/70	95/NR	95	95	95	-	7
- After treatment 1	75/NR	80/NR	90/NR	70/NR	80/NR	85	80	85	70	5
- After treatment 2	60/NR	65/60	65/65	55/55	65/65	70/70	61.6	65	76	3
- After treatment 3	45/45	50/45	50/50	50/50	65/60	65/60	50	50	82	3

Covid-19 = coronavirus disease 2019; AC/BC = air conduction/bone conduction; HL = hearing loss; SRT = speech recognition threshold; SDS = speech discrimination score; NR = no response

positive Rinne's test results bilaterally, but positive Weber test results were lateralised to the right side.

Audiological assessments, including tympanometry, audiometry and bedside tests were performed. Given the prevalence of SARS-CoV-2, these assessments were performed in full compliance with health protocols. The tympanogram showed type A findings in both ears. Audiometric results showed profound hearing loss in the left ear (Table 1).

Our patient had no symptoms of Covid-19. Although Herman *et al.* (2020) do not recommend routinely carrying out reverse transcription polymerase chain reaction tests on nasopharyngeal swabs before starting corticosteroid therapy,⁶ a history of SARS-CoV-2 infection in family members prompted us to request a polymerase chain reaction test for the patient.

Other assessments, such as serological assessment of virus markers and magnetic resonance imaging (MRI) of the brain to rule out abnormalities of the internal auditory meatus, were also requested, to determine the cause of the sudden SNHL.

The next day, after confirmation of Covid-19 on polymerase chain reaction testing, the patient was treated with intratympanic injections of corticosteroids (three injections of dexamethasone (24 mg/ml, the preferred unit dose) were provided over a three-week period).⁷

After the first treatment session, follow-up assessments of pure tone threshold for 0.25–8 kHz, pure tone average (of 0.5, 1 and 2 kHz) and speech audiometry were conducted before each re-injection, as per the treatment protocol. This showed improvement of hearing level and speech perception (Table 1). In addition, the loudness of subjective tinnitus (assessed using numeric rating scales that typically range from 0 or 1 (low loudness) to 10 (high loudness) reduced after treatment, but did not completely disappear (Table 1).

The brain MRI results were normal. In addition, viral serology markers for human immunodeficiency virus, cytomegalovirus, hepatitis B and hepatitis C, and syphilis, were negative. However, C-reactive protein (CRP) levels were increased.

Discussion

We report on a patient referred to us with the only symptom of sudden hearing loss who was diagnosed with Covid-19. The intra-tympanic injection of corticosteroids immediately

improved hearing threshold and speech perception, and reduced tinnitus loudness.

Previous studies mention several mechanisms for sudden hearing loss caused by a virus, including: neuritis caused by viral involvement of the cochlear nerve, cochleitis due to viral involvement of the cochlea and peri-lymphatic tissues, and a stress response resulting in the cross-reaction of inner-ear antigens to viral infections.^{5,8} With a mechanism similar to other viruses, Covid-19 can not only increase inflammatory processes in the cochlea and cause a cytokine storm, but also damage the hair cells, Corti organ and stria vascularis.⁹ Our patient did not have the common Covid-19 symptoms, but the polymerase chain reaction test results were positive, and she had increased CRP levels indicating an increase in inflammatory conditions. However, interpretation of the findings should be treated with caution.¹⁰ Furthermore, the results of other laboratory tests, such as virus tests and imaging, were normal, raising our suspicions of SARS-CoV-2 infection as the cause of sudden SNHL.

Despite the low numbers of studies, it is important to consider the possibility of a relationship between Covid-19 and sudden SNHL. So far, five papers (described below) that report sudden SNHL in a SARS-CoV-2 polymerase chain reaction positive patient have been published. In some of the patients, sudden SNHL was secondary to Covid-19 disease (post Covid-19) and was accompanied by other symptoms; in other patients, sudden SNHL was the only symptom of Covid-19 disease.

Kilic *et al.*, in June 2020, reported that one out of five Covid-19 patients had sudden SNHL and no other common symptoms of Covid-19.⁵ For management of this patient, they used only oral hydroxychloroquine to control Covid-19. Although no common corticosteroid injections were considered, the patient reported hearing improvement after treatment. They focused on treating Covid-19 in order to avoid the detrimental effects of using conventional methods of treating sudden hearing loss with steroids,⁵ although the use of hydroxychloroquine itself can lead to cochlear damage.¹¹ However, their study did not include imaging or laboratory evaluations to rule out other possible causes of sudden SNHL.⁵

Karimi-Galoughi *et al.*, in June 2020, reported three polymerase chain reaction Covid-19 positive patients who presented with SNHL.¹² Their article did not publish detailed information about other assessments or treatments, and only once mentioned the possible relationship between Covid-19 and hearing loss.¹²

In July 2020, Abdel Rhman and Abdel Wahid reported a patient with unilateral sudden SNHL with a positive Covid-19 polymerase chain reaction test result who did not have the common Covid-19 symptoms.¹³ They used intra-tympanic corticosteroid injection (methylprednisolone), which was effective in improving hearing.

In September 2020, Lang *et al.* reported a patient with common Covid-19 symptoms who developed unilateral sudden hearing loss after symptom offset.¹⁴ Three weeks after the hearing loss onset, oral prednisolone was administered to the patient. Unfortunately, as expected, there was no improvement in the patient's hearing because of the delay in treatment.¹⁴

Koumpa *et al.*, in October 2020, described a man in the UK who developed sudden-onset hearing loss a week after transfer out of the intensive care unit following Covid-19.¹⁵ They applied oral prednisolone for one week, which resulted in partial subjective improvement in his hearing. They then used intra-tympanic steroid injection (methylprednisolone), which resulted in no further hearing improvement as observed on pure tone audiograms.¹⁵

These studies highlight the use of corticosteroids in patients with Covid-19. Nevertheless, it is believed that corticosteroid use delays viral RNA clearance; furthermore, corticosteroids have serious side effects.¹⁶ However, Mahase (2020) reported that applying a low dose of steroids may reduce the mortality rate in ventilated patients with Covid-19 by up to one-third, but have no effect on patients with mild Covid-19.¹⁷

Given the conflicting findings regarding the side effects of corticosteroids in Covid-19 patients, the patient in the current case study was treated with intra-tympanic steroid injections. The use of intra-tympanic steroids resulted in higher perilymph steroid levels; it increased chances of recovery (compared with systemic administration) but involved minimal systemic absorption.¹⁵ The advantages of using corticosteroids are well established, as is the likely superiority of intra-tympanic injections compared to systemic administration.⁶ Therefore, it is suggested that in the current situation, in patients with coronavirus, use of intra-tympanic injections may have a minimal risk.

Regarding corticosteroids, we used dexamethasone. In comparison to prednisone and dexamethasone, research shows that dexamethasone has a higher biological half-life and greater anti-inflammatory properties than prednisone. The increased anti-inflammatory properties of dexamethasone may provide advantages for viral and autoimmune aetiologies of sudden SNHL.⁷

- Few studies have reported sudden sensorineural hearing loss (SNHL) as a possible symptom of coronavirus disease 2019 (Covid-19)
- In some patients, sudden SNHL was secondary to Covid-19 (post Covid-19) and was accompanied by other symptoms; in others, sudden SNHL was the only symptom
- In our Covid-19 positive, sudden SNHL patient, hearing threshold and speech perception improved, and tinnitus loudness decreased after intra-tympanic corticosteroid injection
- Coronavirus may be a cause of sudden SNHL
- The hearing status of Covid-19 patients and incidence of Covid-19 in sudden SNHL patients should be considered
- Patients presenting with sudden SNHL who are positive or suspected for Covid-19 should receive intra-tympanic corticosteroid injection

Another point to consider in patients with sudden SNHL is the timing of steroid injection therapy. The sooner the therapeutic intervention is commenced, the better the chances of recovery and the fewer destructive effects on the cochlea.⁶ In the current reported patient, because of their Covid-19 positive

status, treatment with intra-tympanic corticosteroid injection was performed within 72 hours of symptom onset.

Conclusion

This case report supports previous evidence from other case reports and small case series suggesting a possible association between Covid-19 and sudden SNHL. Coronavirus should perhaps be added to the list of known viruses that can lead to sudden SNHL. We recommend that patients who present with sudden SNHL and who are positive for Covid-19 undergo injection therapy immediately. In addition, asking about the hearing status of those with Covid-19 could prompt immediate effective therapeutic action; likewise, determining Covid-19 status or history in cases of sudden hearing loss could help to break the chain of virus transmission, especially in those who have been in close contact with a confirmed or probable case of Covid-19.

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