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Sudden sensorineural hearing loss after COVID-19 vaccination ☆☆☆☆☆

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ABSTRACT

Coronavirus disease 2019 (COVID-19) spread rapidly and was declared a pandemic. In this situation, vaccination for COVID-19 is important and has been prompted in many countries. Rare serious adverse events including Guillain-Barré syndrome, thrombosis with thrombocytopenia syndrome, and myocarditis after COVID-19 vaccinations have been reported. Otolaryngologic adverse events after COVID-19 vaccination were reported, including several cases of sudden sensorineural hearing loss (SSNHL). We report three patients with SSNHL within three days after COVID-19 vaccination and consider an association between them. Although there is no evidence of an association between vaccination and SSNHL, the adverse event of SSNHL after COVID-19 vaccination should be kept in mind because viral infection could be the etiology of SSNHL, which is an otologic emergency that requires prompt treatment with steroids.

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) spread rapidly and was declared a pandemic (Kilic et al., 2020, Iftikhar et al., 2021). At present, more than 200 million people worldwide have been infected, among whom more than four million have died. In this situation, vaccination for COVID-19 is important and is being prompted in many countries.

Rare serious adverse events, including Guillain-Barré syndrome, thrombosis with thrombocytopenia syndrome after adenovirus-vector Janssen COVID-19 vaccination, and myocarditis after messenger ribonucleic acid (mRNA) Pfizer-BioNTech and Moderna COVID-19 vaccinations have been reported (Rosenblum et al., 2021). Otolaryngologic adverse events after COVID-19 vaccination were observed, including several cases of sudden sensorineural hearing loss (SSNHL) reported in the Centers for Disease Control and Prevention (CDC) Vaccine Adverse Events Reporting System (VAERS) in the United States (Formeister et al., 2021).

SSNHL is defined as hearing loss ≥ 30 dB over three consecutive frequencies within three days (Okhovat et al., 2015, Chandrasekhar et al., 2019, Kolarov et al., 2019). The etiology of SSNHL usually is idiopathic, but it can be attributed to viral infection, vasculitis, autoimmune disease, and tumor (Baxter et al., 2016, De Marco et al., 2018, Chandrasekhar et al., 2019). We report three patients with SSNHL within three days after COVID-19 vaccination and consider an association between them.

CASE PRESENTATION

Case 1

A 64-year-old female visited our clinic for sudden hearing loss in the right ear, which had occurred two days prior. The symptom occurred one day after her first dose of COVID-19 vaccination with adenoviral vector Oxford-AstraZeneca. Initial hearing threshold with a weighted four-frequency average ($[500 \text{ Hz} + 1000 \text{ Hz} \times 2 + 2000 \text{ Hz} \times 2 + 4000 \text{ Hz}] / 6$) was 86 dB in the right and 17 dB in the left ear on pure tone audiometry (Figure 1A). She received high-dose oral steroid (prednisolone 60 mg per day for five days, which was tapered for the next five days). Temporal magnetic resonance imaging showed normal findings.

After five days of treatment, hearing threshold improved to 30 dB in the right ear on pure tone audiometry. Due to incomplete recovery and residual symptoms of hearing loss in the right ear, salvage treatment with intratympanic steroid injection (dexamethasone 5 mg every third day for three cycles) was performed. After

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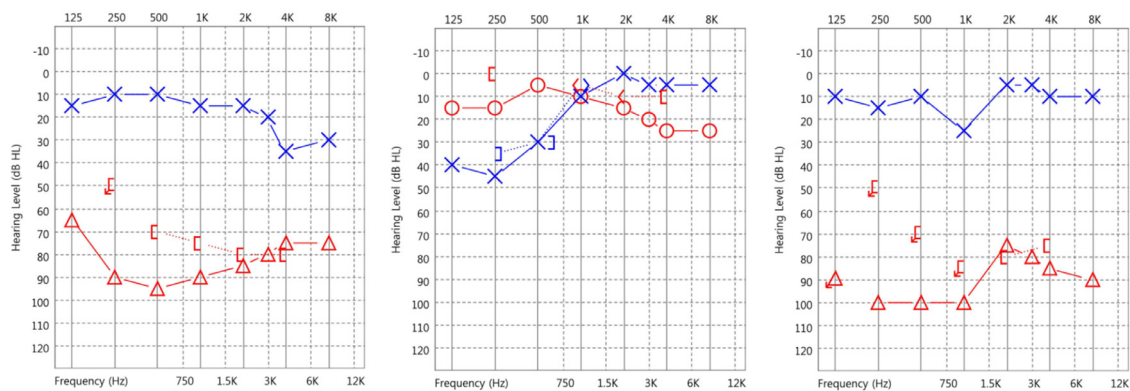


Figure 1. Initial hearing threshold with weighted four-frequency average ($[500 \text{ Hz} + 1000 \text{ Hz} \times 2 + 2000 \text{ Hz} \times 2 + 4000 \text{ Hz}] / 6$) on pure tone audiometry after coronavirus disease 2019 vaccination. (A) In a 64-year-old female with right sudden sensorineural hearing loss after the first dose of Oxford-AstraZeneca, it was 86 dB in the right and 17 dB in the left ear. (B) In a 42-year-old male with left acute low-frequency hearing loss after the first dose of Pfizer-BioNTech, it was 13 dB in the right and 9 dB in the left ear, but there was acute hearing loss at low frequencies in the left ear (40, 45, and 30 dB at 125, 250, and 500 Hz, respectively). (C) In an 18-year-old male with right sudden sensorineural hearing loss after the second dose of Pfizer-BioNTech, it was 89 dB in the right and 13 dB in the left ear.

that, the hearing threshold recovered completely to 16 dB in the right ear on pure tone audiometry.

Case 2

A 42-year-old male visited our clinic for sudden hearing loss in the left ear, which had occurred two weeks previous, with no symptoms of vertigo. The symptom occurred on the day of the first dose of COVID-19 vaccination with Pfizer-BioNTech. Initial hearing threshold with weighted four-frequency average was 13 dB in the right and 9 dB in the left ear on pure tone audiometry, but there was acute hearing loss at low frequencies in the left ear (40, 45, and 30 dB at 125, 250, and 500 Hz, respectively) (Figure 1B). He received high-dose oral steroid (prednisolone 60 mg per day for five days, which was tapered for the next five days).

After treatment with systemic steroid, hearing threshold at low frequencies recovered partially, but symptoms of hearing loss remained. Thus, salvage treatment with intratympanic steroid injection (dexamethasone 5 mg every third day for five cycles) was performed. After intratympanic steroid injection, hearing threshold at low frequencies improved (25, 30, and 10 dB at 125, 250, and 500 Hz, respectively).

Case 3

An 18-year-old male visited our clinic for sudden hearing loss in the right ear, which had occurred two weeks prior. The symptom occurred two days after the second dose of COVID-19 vaccination with Pfizer-BioNTech. Initial hearing threshold with weighted four-frequency average was 89 dB in the right and 13 dB in the left ear on pure tone audiometry (Figure 1C). He received high-dose oral steroid (prednisolone 60 mg per day for five days, which was tapered for the next five days). Intratympanic steroid injection (dexamethasone 5 mg every third day for five cycles) was administered simultaneously due to severe hearing loss. Temporal magnetic resonance imaging showed normal findings.

After treatment with oral and intratympanic steroid, hearing threshold worsened to 100 dB in the right ear on pure tone audiometry.

DISCUSSION

Several cases of SSNHL after vaccination have been reported, including after influenza vaccination (Huang et al., 2010, Baxter et al., 2016, Kolarov et al., 2019), tetanus and diphtheria vaccination as well as meningococcal polysaccharide vaccination (De Marco

et al., 2018), and rabies vaccination (Güçlü and Dereköy, 2013, Okhovat et al., 2015). The etiology of SSNHL after vaccination is unknown (De Marco et al., 2018). In Baxter et al.'s large-scale study, there were no associations between SSNHL and previous vaccination, including trivalent inactivated influenza vaccine and others (Baxter et al., 2016, Formeister et al., 2021).

For the relation of SSNHL and COVID-19 vaccination, Formeister et al. reported that there were no associations between two mRNA COVID-19 vaccinations with Pfizer-BioNTech or Moderna and SSNHL (Formeister et al., 2021). In previously reported SSNHL cases after vaccinations other than the COVID-19 vaccine, the etiologies were unclear. Viral antigens after vaccination could induce immunologic response resulting in release of antibodies and cytokines. Immunocomplex mediation could cause autoimmune response directing antibodies to the cochlea (Okhovat et al., 2015). Immunologic and inflammatory responses might result in vasculitis and vascular ischemia of the cochlea. However, these etiologies including viral infection, vascular ischemia, and autoimmune response are known suspicious causes of SSNHL regardless of vaccination. Nonetheless, SSNHL within three days after COVID-19 vaccination has the possibility that vaccination is the significant cause.

Referring to the association between COVID-19 vaccination and Bell's palsy, which is an acute idiopathic peripheral facial palsy with similar etiologies to SSNHL, might be useful. There have been more reported cases of Bell's palsy after COVID-19 vaccination than those of SSNHL after COVID-19 vaccination. However, the association between facial palsy and COVID-19 vaccination remains unclear (Renoud et al., 2021, Shemer et al., 2021).

The treatment of SSNHL after COVID-19 vaccination is the same as that in the absence of the vaccine. Clinical practice guidelines for SSNHL indicated that corticosteroids can be offered within two weeks as initial therapy (Chandrasekhar et al., 2019). Immediate systemic steroid use in patients with SSNHL after vaccination can inhibit antibody formation in response to the vaccination. However, the effect of systemic steroid use in those patients has not been investigated thoroughly. Corticosteroids, immunosuppressive agents, and immunosuppressive diseases of vaccine recipients can affect the antibody response. For prevention of insufficient immunization after vaccination, intratympanic steroid rather than systemic steroid can be considered, as it might not suppress the immune system systemically (Güçlü and Dereköy, 2013). If systemic high-dose steroid was administered during the vaccination period, the measurement of antibody titer after completion of the vaccination might be necessary.

SSNHL can occur after COVID-19 vaccination, but the mechanism is unclear. Like in SSNHL unrelated to vaccination, prompt

systemic or intratympanic steroid administration is necessary in SSNHL after COVID-19 vaccination.

CONCLUSION

Although there is no direct evidence of the association between vaccination and SSNHL, the adverse event of SSNHL after COVID-19 vaccination should be kept in mind because viral infection could be the etiology of SSNHL.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical Approval

The Institutional Review Board of the authors' institution exempted the review of this study (NHIMC 2021-09-028). Written informed consent was exempted by the Institutional Review Board because this study was retrospective.

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