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Evolution of incidence of audiovestibular disorders during the pandemic COVID-19 period

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Abstract

Purpose Despite sporadic case reports describing hearing problems in patients with coronavirus disease 2019 (COVID-19), whether COVID-19 affects the audiovestibular system remains unclear. This study assessed the evolution of incidence of audiovestibular disorders during the pandemic COVID-19 period.

Method Three audiovestibular disorders namely, sudden sensorineural hearing loss (SSHL), autonomic dysfunction, and Meniere's disease (MD) were analyzed and compared from 2016 to 2020.

Results The annual new cases at our clinic comprised overall 2107, 1997, 1984, 2068, and 1829 from 2016 to 2020, respectively, and the respectively annual cases of SSHL were 54, 46, 42, 45 and 38. Accordingly, annual incidences of SSHL in relation to overall cases of audiovestibular disorders were 2.6%, 2.3%, 2.1%, 2.2% and 2.1% from 2016 to 2020, respectively, exhibiting a non-significant difference ($p > 0.05$). In contrast, incidence of autonomic dysfunction in the year 2020 was 15.3%, which revealed significantly higher than 8.5–13.1% from 2016 to 2019 ($p < 0.001$). Restated, the incidence of autonomic dysfunction in 2020 displayed a significantly higher percentage than the other 4 years. Conversely, the incidence of MD in 2020 was 9.8%, showing a significant decline compared with the other 4 years (12.6–15.6% from 2016 to 2019, $p < 0.001$),

Conclusion Evolution of incidence of audiovestibular disorders during the pandemic COVID-19 period revealed increase in the incidence of autonomic dysfunction and decrease in that of MD, while incidence of SSHL remained unchanged from 2016 to 2020. Thus, the SARS-CoV-2 may less affect the audiovestibular system.

Keywords Autonomic dysfunction · Coronavirus disease 2019 (COVID-19) · Meniere's disease · Sudden sensorineural hearing loss

Introduction

In December 2019, sporadic cases of atypical pneumonia were consecutively encountered in Wuhan, China, and a novel virus termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was later identified as the etiology. The World Health Organization (WHO) declared the global outbreak of coronavirus and coined the term "Coronavirus Disease 2019 (COVID-19)". By the end of 2020, based on WHO COVID-19 dashboard (2020), more than 90 million patients with COVID-19 had been confirmed worldwide, with a mortality rate of 2.2% [1]. Typical symptoms of COVID-19 comprised fever, cough, fatigue, shortness of breath, etc. [2]. In addition, loss of smell and taste were associated neurological symptoms ranging from 5–98% and 6–90% in prevalence, respectively, likely due to direct invasion of the SARS-CoV-2, or inflammatory response by cytokine storm [3–5]. Further, inner ear symptoms, i.e., tinnitus, hearing loss, and balance disorders were also mentioned in sporadic case reports of COVID-19 [6–9]. Whether COVID-19 affects the audiovestibular system remains unclear. If hearing impairment relates to COVID-19, then the incidence of sudden sensorineural hearing loss (SSHL), like hyposmia and hypogeusia, may have increased during the pandemic period of COVID-19. Hence, this study compared evolution of incidence of three audiovestibular disorders namely, SSHL, autonomic dysfunction, and Meniere's disease (MD) from 2016 to 2020.

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Methods

From January 2016 to December 2020, patients with inner ear symptoms and pathological eye movements who visited neurotological clinic of the university hospital for the first time were enrolled in this study. All patients underwent an inner ear test battery comprising audiometry, ocular vestibular-evoked myogenic potential (oVEMP) test, cervical VEMP (cVEMP) test, and bithermal caloric test.

Diagnosis of SSHL is defined as a rapid decline (< 3 days) of more than 30 dB of sensorineural hearing loss in at least three contiguous frequencies without an identifiable cause [10]. Diagnosis of MD was based on the guidelines proposed by the American Academy of Otolaryngology-Head and Neck Surgery and new diagnostic criteria defined by the Barany Society [11, 12]. Diagnosis of autonomic dysfunction was based on the literature [13], namely, (1) non-vestibular dizziness, e.g., light headedness; (2) provocation by sudden postural change or orthostatic hypotension by Schellong test; (3) duration of seconds to several minutes; and (4) at least five of following the symptoms: anxiety, chronic fatigue, cold extremities, fainting, frequent headache, gastrointestinal symptoms, medication intolerance, palpitation, or sleeping disorder, but no rotational vertigo.

This study was approved by the institutional review board of the university hospital, and each subject signed the informed consent to participate.

Statistical methods

The annual incidence of each disorder from 2016 to 2020 was compared by 2×5 Chi-square test. Associations between each year and cases of audiovestibular disorder were determined by binary logistic regression. The produced coefficients and standard errors were exponentiated to create odds ratio (OR) with their respective 95% confidence interval (CI). A significant difference indicates $p < 0.05$.

Results

Evolution of incidence of SSHL

From January 2016 to December 2020, the annual new cases of audiovestibular disorders at the neurotological clinic of a university hospital were 2107, 1997, 1984, 2068, and 1829, respectively, and the respectively annual cases of SSHL were 54, 46, 42, 45 and 38 (Table 1). Accordingly, annual incidences of SSHL in relation to overall cases of audiovestibular disorders were 2.6%, 2.3%, 2.1%, 2.2% and 2.1% from 2016 to 2020, respectively, exhibiting a non-significant difference ($p > 0.05$, Fig. 1). Additionally, binary logistic regression (SSHL vs. non-SSHL cases) to compare 2020 (COVID year) with the other 4 years (2016–2019) yielded no significant difference in the odds ratio ($p > 0.05$, Table 1).

Evolution of incidence of autonomic dysfunction

Table 2 summarizes the incidence of autonomic dysfunction from 2016 to 2020. Unlike SSHL, the incidence of autonomic dysfunction in the year 2020 was 15.3%, which revealed significantly higher than 8.5–13.1% from 2016 to 2019 ($p < 0.001$, Fig. 2). Restated, the incidence of

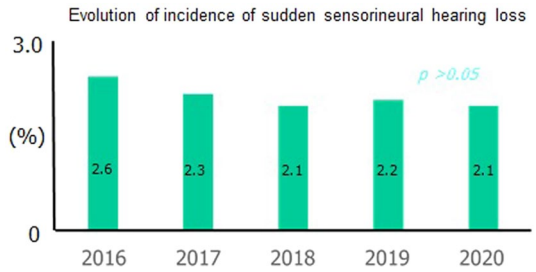

Fig. 1 The annual incidences of sudden sensorineural hearing loss in relation to overall cases of audiovestibular disorders are 2.6%, 2.3%, 2.1%, 2.2% and 2.1% from 2016 to 2020, respectively, exhibiting a non-significant difference ($p > 0.05$)

Table 1 Incidence of sudden sensorineural hearing loss (SSHL) in relation to overall neurotological cases

Year	SSHL Case no	Overall Case no	Incidence	Odds ratio (95% CI)	*p* value[#]
2016	54	2107	2.6%	1.240 (0.815–1.886)	0.316
2017	46	1997	2.3%	1.111 (0.720–1.716)	0.634
2018	42	1984	2.1%	1.019 (0.654–1.588)	0.933
2019	45	2068	2.2%	1.048 (0.678–1.622)	0.832
2020 (COVID-19)	38	1829	2.1%	1	
p value*			> 0.05		

CI confidence interval

*2×5 Chi-square test

[#]Binary logistic regression, when compared with year 2020

Table 2 Incidence of autonomic dysfunction in relation to overall neurotological cases

Year	Autonomic dysfunction Case no	Overall Case no	Incidence	Odds ratio (95% CI)	*p* value[#]
2016	180	2107	8.5%	0.515 (0.422–0.629)	< 0.001
2017	197	1997	9.9%	0.606 (0.498–0.735)	< 0.001
2018	258	1984	13.0%	0.827 (0.689–0.992)	0.041
2019	271	2068	13.1%	0.838 (0.697–0.999)	0.048
2020 (COVID-19)	280	1829	15.3%	1	
p value*			< 0.001		

CI confidence interval

*2 × 5 Chi-square test

[#]Binary logistic regression, when compared with year 2020

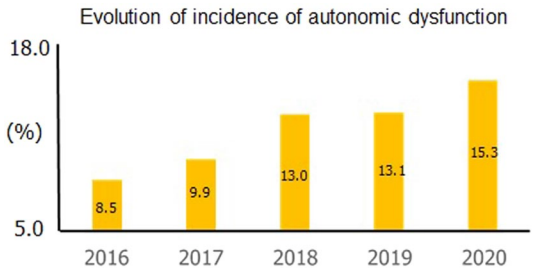

Fig. 2 The annual incidence of autonomic dysfunction in 2020 displays a significantly higher percentage than the other 4 years (2016–2019, $p < 0.001$)

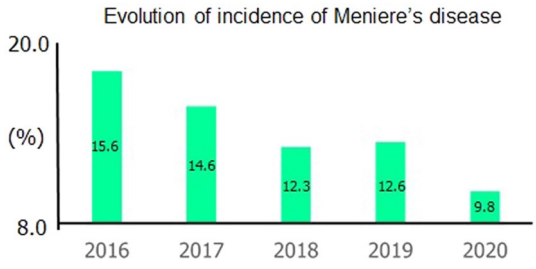

Fig. 3 The annual incidence of Meniere's disease in 2020 displays a significantly lower percentage than the other 4 years (2016–2019, $p < 0.001$)

autonomic dysfunction in 2020 displayed a significantly higher percentage than the other 4 years. Additionally, binary logistic regression to compare 2020 with the other 4 years also yielded a significant difference in the odds ratio ($p < 0.05$, Table 2).

Evolution of incidence of MD

Conversely, the incidence of MD in 2020 was 9.8%, compared with 15.6% (2016), 14.6% (2017), 12.3% (2018) and 12.6% (2019), exhibiting a significant decline from 2016 to 2020 ($p < 0.001$, Fig. 3). Further, binary logistic regression also identified a significant difference in the odds ratio between 2020 and the other 4 years ($p < 0.05$, Table 3).

Discussion

In addition to respiratory symptoms, associated neurosensory deficits such as hyposmia and hypogeusia are frequently present in COVID-19 patients, likely due to direct invasions of the SARS-CoV-2 or inflammatory response by cytokine storm [14]. Meanwhile, tinnitus or hearing loss is occasionally mentioned in sporadic case reports [6–9]. Comparing the annual incidence of SSHL at our hospital in 2020 with that in 2016–2019 (Fig. 1), no significant difference was identified over the past 5 years (Table 1), indicating that SSHL in COVID-19 patients is coincidental rather than a cause-and-effect relationship. Notably, some COVID-19 patients treated by chloroquine may experience hearing loss/tinnitus, and ototoxicity by chloroquine should be differentiated from SSHL [15]. Furthermore, those with slight hearing decline or a gradual or delayed loss, but not SSHL, otoscopy is essential to exclude concomitant ear infection.

During the pandemic period of COVID-19, more and more patients with autonomic dysfunction were experienced at our clinic (Fig. 2). Unlike SSHL, the incidence of autonomic dysfunction in 2020 (15.3%) is significantly higher than the other 4 years (8.5–13.1%, Table 2), probably because of increased psychological stress, panic, anxiety, or depression associated with social isolation in time of a pandemic COVID-19 period [16].

On the other hand, those who spent too much time focusing on the outbreak or the epidemic progression may also have developed autonomic dysfunction. As a result, it is not surprising that an increased numbers of patients with autonomic dysfunction visited our clinic in the most arduous year, 2020 (Fig. 2).

Table 3 Incidence of Meniere's disease (MD) in relation to overall neurotological cases

Year	MD Case no	Overall Case no	Incidence	Odds ratio (95% CI)	*p* value[#]
2016	329	2107	15.6%	1.641 (1.358–1.982)	< 0.001
2017	291	1997	14.6%	1.567 (1.242–1.829)	< 0.001
2018	245	1984	12.3%	1.246 (1.021–1.521)	0.031
2019	261	2068	12.6%	1.297 (1.066–1.578)	0.009
2020 (COVID-19)	180	1829	9.8%	1	
p value*			< 0.001		

CI confidence interval

*2 × 5 Chi-square test

[#]Binary logistic regression, when compared with year 2020

Conversely, the incidence of MD in 2020 (9.8%) is significantly lower than the other 4 years (12.6–15.6%, Fig. 3, Table 3) despite the pandemic environment. Although one may argue that MD patients did exist, yet they just never presented for medical care. Nevertheless, such reason opposed to the phenomenon that patient numbers of autonomic dysfunction increase.

In February 2020, the policy for eliminating the spread of COVID-19 was carried out by the government, based on the past experience on SARS in 2003 [17]. For example, enforcement of a 14-day quarantine period for travelers arriving from abroad is required. Airport checkpoints have already been set up to screen passengers, where they are given temperature checks, a nasopharyngeal swab for detecting the viral load, and asked to fill out health declaration forms. All subjects are required to wear masks in public areas. Those with positive cases of COVID-19 should wear N-95 masks and immediately be placed in isolation facilities with negative pressure. Meanwhile, all subjects are required to wear masks in public areas, i.e., hospital, school, theater, concert, market, gym, transportation, etc.

Many events are suggested to trigger Meniere attacks such as weather change, common cold, mental stress, etc. Mizukoshi et al. [18] reported that the Meniere attack is influenced by the passing of a cold front, defined as the following conditions, namely (1) fall in temperature by > 5 °C, (2) increased humidity, (3) strong wind > 10 m/s, (4) rain or snow, (5) thunder, and (6) wind shifting from south to north-west in Toyama Prefecture, Japan. However, because a cold front containing multiples factors, clinicians are not clear with which meteorological parameter is responsible for Meniere attack.

Wearing masks helps avoid significant temperature change and infection because the common cold is a precipitating factor for a Meniere attack [19, 20]. The advantage of wearing masks under weather change, pending further validation, may help eliminate the precipitating factors, i.e., common cold or temperature change for vertiginous attack. Hence, in the future, when facing seasonal change, i.e., a cold front, MD patients are advised to wear masks avoiding vertiginous attack.

Conclusion

Evolution of incidence of audiovestibular disorders during the pandemic COVID-19 period revealed increase in the incidence of autonomic dysfunction and decrease in that of MD, while incidence of SSHL remained unchanged from 2016 to 2020. Thus, the SARS-CoV-2 may less affect the audiovestibular system.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Sponsorships None.

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