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COVID-19 “Long-Haulers”: The Emergence of Auditory/Vestibular Problems After Medical Intervention

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> **NOTE:** The term “long-hauler” has been used identify a COVID-19 survivor but developed other medical problems after treatment has been concluded. These ‘late-onset’ problems are sometimes referred to a *Chronic COVID-19 Syndrome* (Baig, 2020).

The auditory-vestibular side effects of any illness, or from a pharmaceutical, nutraceutical, noise, or trauma, as well as any psychogenic component, will always be a concern for audiologists. With COVID-19, it is still too early to predict auditory-vestibular side effects, although several studies have attempted to do so or at least guide us in our short and long-term management.

As of November 21, 2020, Johns Hopkins University’s Center for Systems Science and Engineering (CSSE) (2020) in the United States reported over 12 million documented cases of COVID-19 and over 255,000 deaths since the virus was first identified in the United States in January, 2020.

Early in the pandemic, the medical profession, the Centers for Disease Control and Prevention (CDC), the National Institute of Health (NIH), and both federal and state governments worked 24/7 to develop testing protocols and intervention strategies (pharmacological management and vaccines).

Until a scientifically proven intervention strategy is identified along with a vaccine (projectd for December 2020), the public continues to be advised by the CDC to wear face masks, socially distance from each other, wash their hands regularly and avoid crowds/indoor events. This major change in our lifestyle/behavior and the associated economic impact is still with us today.

As a novel virus, no assumptions can be made about treatment or management strategies or prediction of late onset of new symptoms. Within a few months after the pandemic was declared, a variety of pharmacological interventions were proposed by the federal government - all without scientific evidence. The most popular unproven intervention strategy in the United States was the combined use of two known ototoxic drugs: hydroxychloroquine and azithromycin (Bortoli and Santiago, 2007; FDA, 2017; Prayuenyong. et al, 2020).

DiSogra (2020a) provides a detailed review of this strategy from an audiologist's perspective. In Europe, hydroxychloroquine and chloroquine were prescribed for almost 12 percent of COVID-19 patients (Lechien et al, 2020).

Researchers attempted to determine if other FDA-approved drugs could be repurposed as an intervention strategy. A summary of several FDA-approved drugs that were being repurposed for COVID-19 patients appears in DiSogra (2020b).

Vaccines for COVID-19 are still undergoing clinical trials. The U.S. National Library of Medicine's Clinical Trials website is monitoring over 80 COVID-19 vaccine-related clinical trials (in various phases of development) worldwide as of September 24, 2020.

COVID-19 Recovery

A self-organized group of COVID-19 "long-haul" patients, who also happen to be researchers in relevant fields (e.g., participatory design, neuroscience, public policy, data collection and analysis, human-centered design, health activism) and have intimate knowledge of COVID-19, have been working on patient-led research around the COVID experience and prolonged recoveries (Assaf et al, 2020).

To capture and share the experiences of patients suffering from prolonged or long-haul COVID-19 symptoms, survivor/researchers used a data-driven participatory-type survey and patient-centric analysis. With 640 survey respondents, many participants experienced fluctuations in the type (70 percent reporting) and intensity (89 percent reporting) of symptoms over the course of being symptomatic.

For approximately 10 percent who had recovered, the average length of time of being symptomatic was 27 days. Unrecovered respondents experienced symptoms for an average of 40 days, with a large proportion experiencing symptoms for five to seven weeks. The chance of full recovery by day 50 was smaller than 20 percent.

Most common auditory/vestibular symptoms were earaches and vertigo lasting up to eight weeks

after the diagnosis. Sixty percent of the respondents reported balance issues that peaked by second week and subsided over the next four weeks. Earaches (~32 percent) and vertigo/motion sickness (~25 percent) persisted over six weeks. One patient reported hearing loss that recovered after three weeks. Subjects listed tinnitus as the second highest complaint on a write-in list of symptoms.

All patients experienced a full recovery after 90 days except for patients with pre-existing asthma. The majority of survey respondents were not hospitalized; however, a large number of participants (37.5 percent) had visited the emergency rooms or urgent care but were not admitted for further testing or overnight observation.

Auditory Symptoms After COVID-19 Treatment

For this manuscript, “auditory symptoms” is defined as hearing loss (any degree/type), earache, subjective tinnitus, or vertigo/balance problems.

Sensorineural Hearing Loss

Almufarrij et al (2020) conducted a rapid systematic review investigated audio-vestibular symptoms associated with coronavirus. They found five case reports and two cross-sectional studies that met the inclusion criteria (N=2300). No records of audio-vestibular symptoms were reported with the earlier types of coronavirus (i.e., severe-acute respiratory syndrome [SARS] and Middle East respiratory syndrome [MERS]).

Reports of hearing loss, tinnitus, and vertigo were rarely reported in individuals who tested positive for the SARS-CoV-2. They opined that reports of audio-vestibular symptoms in confirmed COVID-19 cases are few “with mostly minor symptoms, and the studies are of poor quality.”

Almufarrij et al (2020) concluded that it was unclear which cases of hearing loss [and tinnitus] can be directly attributed to SARS-CoV-2 or perhaps related to the many possible causes of hearing loss associated with critical care including ototoxic mediations (Ciorba et al. 2020), local, or systematic infections, vascular disorders and auto-immune disease.

Elbiol (2020) reported only one case (N=121) of sudden hearing loss (0.6 percent). A case report of sudden hearing loss that occurred one week after hospitalization was also published by Koumpa et al (2020).

Conductive Hearing Loss

Fiden (2020) reported one COVID-19 patient with a unilateral otitis media. The conductive hearing loss was mild to moderate.

Tinnitus

Tinnitus was reported in four studies in 2020 (N?=?8 patients; Cui et al, Fidan, Lechien et al, and Sun et al). The characteristics of the tinnitus and the impact on the individual were not reported.

Almufarrij, et al (2020) followed 121 COVID-19 patients eight weeks after discharge. Sixteen (13.2 percent) patients reported a change in hearing and/or tinnitus after diagnosis of COVID-19. However, there was no pattern for the duration of the recovery.

Some patients showed no changes in tinnitus while one patient reported no tinnitus after eight weeks. There was self-reported tinnitus in eight cases with three reporting a pre-existing hearing loss. Another patient reported that their tinnitus resolved. Elibol (2020) noted that tinnitus is rarely seen in COVID-19 patients.

Liang et al (2020) attempted to identify and describe neurosensory dysfunctions (including tinnitus) of COVID-19 patients. A total of 86 patients were screened but only three (3.5 percent) were identified as having tinnitus. The average interval from onset of tinnitus was one day; while the average interval from onset of tinnitus to admission was 6 ± 5.29 days; the average duration of tinnitus was 5 ± 0 days. Finally, a non-organic component of the tinnitus (i.e., anxiety) cannot be ruled out (Xia et al, 2020). Although the current studies indicate a low incidence of tinnitus in these patients, development of tinnitus management protocol may be beneficial.

Vertigo

The Almufarrij study (2020) identified one patient with hearing loss that also reported vertigo, which the authors concluded may have been vestibular in origin. TABLE 1 summarizes the earliest case reports and cross-sectional study designs that identified auditory/vestibular problems.

TABLE 1. Summary of published case reports and cross-sectional research that identified some type of auditory/vestibular problems (adapted from Almufarrij et al, 2020).

AUTHOR	TYPE OF STUDY	N	AUDITORY/VESTIBULAR SYMPTOMS
Asaaf et al, 2020	Survey	640	Earaches (32 %) Vertigo (60%) Hearing Loss (0.15%)
Ciu et al, 2020	Case Report	20	Tinnitus (N=1) Otitis media (N=1)
Fiden, 2020	Case Report	1	Tinnitus Otitis media
Han et al, 2019	Case Report	1	Vertigo
Lechien et al, 2019	Cross Sectional	1420	Ear pain (N=358 or 25%) Rotary vertigo (N=6 or 0.4%) Tinnitus (N=5 or 0.3%)
Mustafa, 2020	Cross Sectional	20	Sensorineural HL
Sriwijitalai and Wiwanitkit, 2020	Case Report	82	Sensorineural HL (N=1 or 1.2%)
Sun et al, 2020	Case Report	1	Sensorineural HL

The Mustafa study (2020) compared two groups of patients (asymptomatic SARS-CoV-2 vs. control), and the results found that the asymptomatic SARS-CoV-2 group had significantly poorer hearing thresholds at 4-8?kHz and lower amplitude transient evoked otoacoustic emissions (Mustafa, 2020). Almufarrij et al (2020) concluded that high-quality studies are required in different age groups to investigate the acute effects of coronavirus. These studies include temporary effects from medications as well as studies on long-term risks on the audio-vestibular system.

Some Intervention Strategies

Aside for re-purposed pharmaceuticals, dietary supplements are proposed as a treatment option (DiSogra, 2020c). In the Aasaf study (2020), Tylenol® (followed by an inhaler) were the top medications taken by respondents in their survey to treat symptoms. Supplements, such as vitamin C, vitamin D, zinc and electrolytes, were taken by many of the respondents over several weeks. Hot liquids were also very popular with the respondents.

Other popular entries for medications, supplements and treatments reported by participants included Mucinex®, prednisone, steroids, ginger, magnesium, steam, probiotics, oregano oil/supplements, Flonase®, and other nasal sprays.

The majority of respondents never consumed any of the following substances: smoke/vape nicotine, edible or liquid cannabis, smoke/vape recreational cannabis, consume or smoke cannabidiol-only products or consume recreational drugs. Many of the respondents said they occasionally or frequently consumed alcoholic beverages.

Conclusion

The auditory-vestibular side effects of any illness, or from a pharmaceutical, nutraceutical, noise, or trauma, as well as any psychogenic component, will always be a concern for audiologists. With COVID-19, it is still too early to predict auditory-vestibular side effects, although several studies have attempted to do so or at least guide us in our short and long-term management.

If these “long-hauler” patients can be followed more closely, a body of knowledge should emerge that will help audiologists better manage COVID-19 survivors when their auditory/vestibular symptoms result in a referral for testing. It would appear that conductive and sensorineural hearing loss, tinnitus (including its non-organic origin) and vertigo can be expected but with no predictable pattern.

Protocols for management will need to be developed; however, in the interim, an ototoxic drug monitoring protocol can serve as a reference (American Academy of Audiology, 2009). The duration of these symptoms (after the diagnosis) can last from one day to eight weeks but, again, it is still too early in the life of this pandemic to state definitively if these symptoms are temporary or permanent. Although no formal protocols have been developed, audiologists must keep in mind that the more severe, life-threatening side effects of COVID-19 will continue to get researcher’s attention.

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