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INNER EAR, NOSE AND PHARYNX – SIGNS AND SYMPTOMS OF CORONAVIRUS DISEASE 2019 INFECTION

UNUTRAŠNJE UVO, NOS, ŽDRELO – SIMPTOMI I ZNACI BOLESTI COVID-19

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Summary

Introduction. The most common clinical symptoms of coronavirus disease 2019 include cough, high body temperature, malaise, weakness, headache, and diarrhea. When the pandemic slowed down, more and more patients reported symptoms atypical for the infection, such as hearing loss, tinnitus, and vertigo. The aim of this study was to assess current knowledge and data on the existence and prevalence of otorhinolaryngology sings and symptoms of coronavirus disease 2019. **Material and Methods**. The literature was reviewed from May to December 2022 and included articles published in 2020 or later. The main criterion was confirmed severe acute respiratory syndrome coronavirus 2 infection by means of the polymerase chain reaction test. **Results**. Sensorineural hearing loss presents as acute, chronic and subclinical. Tinnitus is associated with direct viral invasion and social factors. Vertigo is also associated with direct viral invasion and prolonged bed rest. Olfactory and gustatory disorders are known symptoms of viral infections. Olfactory dysfunction occurs as a consequence of the existence of angiotensin-converting enzyme 2 receptors in the nasal mucosa, which is the primary site for viral binding, and which explains the absence of nasal congestion. It has been shown that the pediatric population presents with different clinical symptoms of the infection. In children, rhinorrhea and pharyngitis are the most common symptoms, while in adults they are generally absent. **Conclusion**. The available literature data showed that otorhinolaryngology symptomatology of coronavirus disease 2019 is present, but the data are still very limited. The literature showed vast discrepancies in the prevalence and risk factors associated with coronavirus disease 2019. It is imperative that more research is done on the topic now that the pandemic is subsiding, and more attention should be paid to non-life-threatening symptoms.

Key words: COVID-19; Signs and Symptoms; Labyrinth Diseases; Nose Diseases; Pharyngeal Diseases; Hearing Loss; Vertigo; Tinnitus; Audiology; Otolaryngology

Sažetak

Uvod. Uobičajena klinička slika COVID-19 oboljenja se sastoji iz kašlja, visoke telesne temperature, slabosti, malaksalosti, glavobolje i dijareje. Kada se usporio talas pandemije, sve više pacijenata je prijavilo simptome koji su bili netipični za infekciju. Ti simptomi su bili gubitak i oštećenje sluha, tinitus, vertigo. Cilj ovog rada bio je da se proceni trenutno dostupno znanje i podaci o postojanju i prevalencije otorinolaringoloških simptoma COVID-19 infekcije. **Materijal i metode**. Literatura je pregledana od maja do decembra 2022. godine. Literatura je morala da bude objavljena najkasnije 2020. godine. Glavni kriterijum je bila potvrda postojanja SARS-CoV-2 infekcije putem testa lančane reakcije polimeraze. **Rezultati**. Senszorineuralno oštećenje sluha je prijavljeno kao akutno, hronično i supkliničko. Tinitus je povezan sa direktnom virusnom invazijom i socijalnim faktorom. Vertigo je takođe povezan sa direktnom virusnom invazijom ali i produženim ležanjem. Olfaktorna i gustatorna disfunkcija su poznati simptomi virusnih infekcija. Olfaktorna disfunkcija nastaje kao posledica postojanja angiotenzin-konvertujućeg enzimskog receptora u nosnoj sluzokoži za koje se vezuje virus, što objašnjava nedostatk nazalne kongestije. Pokazalo se da pedijatrijska populacija ima drugačiju kliničku sliku. Kod dece, rinoreja i faringitis predstavljaju neke od najčešćih simptoma dok se kod odraslih izuzetno retko javljaju. **Zaključak**. Podaci dostupni u sadašnjoj literaturi nam pokazuju da je otorinolaringološka simptomatologija COVID-19 infekcije prisutna ali su podaci i dalje veoma oskudni. Literatura pokazuje velike diskrepance kod prevalencije i faktora rizika povezanim sa COVID-19 oboljenjem. Imperativ je da se dodatna istraživanja urade na datu temu sada kada pandemija jenjava i kada se više pažnje može posvetiti životno neugrožavajućim simptomima.

Ključne reči: COVID-19; znaci i simptomi; bolesti unutrašnjeg uha; oboljenja nosa; oboljenja ždrela; gubitak sluha; vrtoglavica; zujanje u ušima; audiologija; otorinolaringologija

Introduction

Coronaviruses are ribonucleic acid (RNA) viruses that cause diseases in mammals and birds. In mammals, they commonly cause respiratory tract infections with symptoms like malaise, general weakness and headache and gastrointestinal symptoms, mostly diarrhea. As the number of coronaviruses rises, they are classified into 4 genera: alpha, beta, delta, and gamma. Currently, 45 types of coronaviruses are known, out of which 7 that infect humans have been identified. Common human coronaviruses include types 229E, OC43, NL63, HKU1, but they are also the least known since they usually do not cause symptoms in immunocompetent people. If they do cause symptoms, they are usually flu-like symptoms. Severe acute respiratory

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Abbreviations

COVID-19	– coronavirus disease 2019
SARS-CoV-2	– severe acute respiratory syndrome coronavirus 2
PCR	– polymerase chain reaction
ACE2	– angiotensin-converting enzyme 2
RNA	– ribonucleic acid
ENT	– ear, nose, throat
MRI	– magnetic resonance imaging
TEOAE	– transient evoked otoacoustic emission

syndrome coronavirus 2 (SARS-CoV) and Middle East respiratory syndrome coronavirus are viruses of animal origin and are linked to epidemics in 2002 and 2012. If we take into account big viral genomes, a lot of genetic variants, frequent recombination within the viral genetic material, wide distribution and ever more frequent interactions between humans and animals, we can assume that epidemics and pandemics like these will periodically be active [1].

The COVID-19 is a disease caused by SARS-CoV-2, which is the newest type in the Coronaviridae family, and it is the seventh type of beta coronavirus. It is a zoonosis; the virus is transmitted via droplets from respiratory tract of infected persons, either directly to the exposed individual, or indirectly to exposed surfaces which healthy individual will come in contact with. The infected persons are usually contagious two days before the symptoms appear and in the first few days of illness. People who develop a severe clinical presentation can be infections even longer. Also, asymptomatic cases are a major problem, because they may disseminate the virus unknowingly. Clinical symptoms usually develop 4 to 5 days after exposure to the virus [1].

The S protein, which binds to angiotensin-converting enzyme 2 (ACE2) receptor, is the most important for the pathogenesis of the virus, while ACE2 receptors are found in many tissues of the human body which explains the broad spectrum of symptoms. Factors such as older age, male sex, ethnicity, high body mass index, hypertension, obesity, immunosuppressants, diabetes, and cardiovascular diseases cause higher expression of ACE2 receptors which may lead to a more severe clinical presentation [2].

When the virus comes in contact with the host's cells after binding to ACE2 receptors, viral RNA enters the cells, it replicates and infects the surrounding cells and this process repeats until it reaches alveoli. Alveolar destruction causes loss of vascular integrity and increased capillary permeability. This leads to pulmonary edema, hypoxia, and progressive lung damage. After local destruction, virus enters the bloodstream and disseminates through the organism. When the immune system is activated, "cytokine storm" leads to hypotension and acute respiratory distress syndrome [3].

As mentioned above, symptoms of virus infection include cough, high body temperature, malaise, weakness, headache, and diarrhea. On the other hand, when the first pandemic wave slowed down, more and more people reported some manifestations that differ from usual presentation, including hearing loss, tinnitus, vertigo and other symptoms that are in the domain of otorhinolaryngology [1, 4].

Symptoms that were linked to COVID-19 by general public, loss of smell and taste, are ear, nose, and throat (ENT) symptoms. There is a wide range of ENT symptoms that have been reported with different prevalence and risk factors in a number of studies. Symptoms that have been reported are sensorineural hearing loss, deafness, tinnitus, vestibular disorders, olfactory and gustatory dysfunction, pharyngitis, tonsillitis, and rhinorrhea [4].

Some of the pathophysiological mechanisms that are speculated to be the cause of auditory and vestibular symptoms are immunological, vascular and cellular. The virus is neurotrophic and neuroinvasive and it damages the cochlear nerve leading to hearing loss, deafness, and balance disorders. Besides the mentioned mechanism, the ACE2 receptors are expressed in the temporal lobe and cerebellum, which can explain how the virus links to hearing and balance part and of the brain. Presence of virus in the bloodstream causes a prothrombotic state which leads to production of small thrombi that mainly affect small vessels, such as vessels of the cochlea that leads to ischemia and distress of the inner ear receptors. In addition to mentioned mechanisms, it also leads to inflammation that causes release of cytokines which has negative impact on the inner ear cells [3–5, 7].

Tinnitus is explained by the above mentioned mechanisms with an addition of social factors. Tinnitus is a condition that is easily aggravated with stress, meaning that the pandemic as a factor itself cannot be excluded. New onset or worsening of tinnitus may have a dual etiology: above explained mechanisms where SARS-CoV-2 leads to metabolism changes, and stress from being in quarantine, social isolation, and depression with no direct link with the virus itself [8, 9].

Olfactory dysfunction is not new to medicine when it comes to viral infections, but it is a pathophysiological mechanism that is different in COVID-19. Loss of smell and taste has previously been linked to nasal obstruction and rhinorrhea. However, since COVID-19 leads to nasal obstruction and rhinorrhea in small percentage of cases, it is speculated that SARS-CoV-2 leads directly to the damage of mucosa and it invades the nervous system that participates in smell and taste functions. Invasion of the olfactory bulb is found on magnetic resonance imaging (MRI) of the infected patients [8, 10, 11].

Rhinorrhea is a common symptom of viral infections in general, but it is uncommon as a COVID-19 manifestation. Reasons for the lack of this symptom are still unknown [3].

Pharyngitis and tonsillitis are caused by direct viral invasion of the mucosa, as it is the case with viral infections in general [3, 12].

The aim of this paper was to confirm that COVID-19 is not only a respiratory infection and that it affects the ENT region as well.

Hypotheses:

1. COVID-19 affects the ENT region;
2. COVID-19 can cause both short-term and long-term ENT consequences.

Material and Methods

This retrospective review included data bases such as PubMed, MEDLINE, Web of Science, and Google Scholar. The review was conducted from June to December 2022.

The key words used in the research were SARS-CoV-2, COVID-19, ENT, otorhinolaryngology, audiology, balance, hearing loss, deafness, vertigo, tinnitus, smell, taste, olfactory dysfunction, gustatory dysfunction, rhinorrhea, anosmia, pharyngitis, and tonsillitis.

Confirmed COVID-19 infection by means of PCR was the main inclusion criterion. Studies and case reviews without COVID-19 positive PCR were not included. All reviewed papers were in English. The study included articles published in 2020 or later.

Results

Sensorineural hearing loss

The first case study mentioning sensorineural hearing loss was by Sriwijitalai W. and Wiwanitkit from Thailand, where one female patient out of 82 came forward with a new-onset hearing loss which was confirmed by tone audiometry. It was reported that the patient received all necessary supportive and symptomatic treatment for her general condition, but it was not mentioned if she received any treatment specifically for hearing loss. Tone audiometry in post-infectious period did not show any improvement [13].

Degen C. et al. reported a patient (60-year-old male) who was in the state of hyperactive delirium after 13 days in the intensive care unit. After resolution of psychotic symptoms, the patient experienced deafness in the right and hearing loss in the left ear. Tone audiometry confirmed the findings and MRI was performed. It showed that an inflammatory process in the right cochlea may lead to ossification. Therefore, right ear cochlear implantation was performed before ossification occurred. The left ear was treated by intratympanic steroid injections. During hospitalization, the patient received azithromycin and furosemide, both ototoxic, but they were ruled out as the cause of hearing loss because they would have caused equal bilateral hearing loss without changes on the MRI [14].

Abdel Rahman S. and Abdul Wahid A. reported a 52-year-old male patient with a left-sided hearing loss and progressive tinnitus. He was positive for COVID-19, but showed no other symptoms except hearing loss. Tone audiometry confirmed it, but the MRI showed no changes. After 3 intratympanic steroid injections, the patient partially restored function [15].

Saniasiaya J. reported a 45-year-old male patient with asthma who required ventilation in the intensive care unit and who was intubated for 30 days. Later, the patient developed pulmonary hypertension, pulmonary embolism, ventilator acquired pneumonia, and anemia. His treatment included remdesivir and intravenous steroids. A week after extubation the patient developed tinnitus and hearing loss on the left side. Two days before the onset of cochlear symptoms, the patient received teicoplanin and ciprofloxacin. No known ototoxic drugs were administered. Hearing loss was confirmed with tone audiometry (threshold was 65, 75, 75, 85 dB on 2, 3, 4, 6 kHz, respectively) while MRI showed no changes. The patient received 60 mg of prednisolone orally, after which intratympanic administration was introduced. Only partial improvement was recorded (TA: 55, 60, 60, 80 dB on 2, 3, 4, 6 kHz, respectively) [6].

Kilic O. et al. conducted a research in Turkey including 5 patients who came to ENT Clinic with acute hearing loss as an isolated symptom. After hearing loss was confirmed, PCR was performed and one patient was positive. People with negative PCR were treated with 1mg/kg/day of prednisolone per os, vitamin B complex, folic acid and protein pump inhibitors, while the COVID-19 positive patient was treated with 200 mg of hydorxychloroquine twice a day. All patients restored hearing completely in 10 - 14 days, including the COVID-19 positive patient who was on antiviral drugs instead of steroids [16].

Mustafa M.W.M. conducted a study in Egypt comparing otoacoustic emissions and tone audiometry tests between asymptomatic COVID-19 positive patients and healthy people. The test group included 20 COVID-19 positive patients, while the control group included 20 healthy people (hearing threshold over 15 dB). To exclude age-related effects on the inner ear, patients were aged from 20 to 50 years. Two weeks after COVID-19 confirmation, otoacoustic emissions and tone audiometry were conducted in both test and control group. Statistically significant difference was found between two groups by tone audiometry at 4, 6 and 8 kHz ($p < 0.05$), as well as by otoacoustic emissions ($p < 0.001$). Tone audiometry and otoacoustic emissions were worse in the test group, even though people did not have any symptoms and their hearing loss was subclinical but very much real. Transient evoked otoacoustic emission (TEOAE) showed that there was damage to the outer hearing cells without clinically manifested hearing loss. This study also showed that even without severe clinical presentation, other organs, apart from the respiratory system, can be involved [17].

Saniasiaya researched a database in Malaysia and concluded that 35 patient aged 20 to 60 years met criteria for COVID-19 related hearing loss. All patients had a hearing loss (partial or complete) as the primary symptom, while secondary symptoms were tinnitus, otalgia, and vertigo. Tone audiometry, TEOAE and tympanometry were used to confirm the findings [6].

Fancello V. et al. used a questionnaire and concluded that the most common ENT symptom of SARS-CoV-2 infection is sensorineural hearing loss that occurred in 15 out of 20 patients with ENT symptoms. Out of 15 patients with hearing loss, 5 had isolated hearing loss, 7 had hearing loss and tinnitus, while 3 patients had hearing loss, tinnitus and vertigo. In this study, they reported that 23.2% out of 185 patients had tinnitus after COVID-19 confirmation. The negative side of this questionnaire is inability to objectively measure tinnitus and possible involvement of other factors in tinnitus development (pandemic, isolation, depression, anxiety) [18].

Tinnitus

Beukes E. et al. performed a meta-analysis on tinnitus using the available literature published up to March 21, 2021. Their focus was on researching the impact of virus itself on tinnitus and the impact of pandemic on tinnitus. Their analysis included 35 patients with auditory symptoms aged 23 to 67 (mean age 42). Out of 35 patients, 14 had tinnitus (40%), 6 were male (43%) and 8 female (57%). This study showed no correspondence in location of tinnitus. Also, there was no consistency regarding the time of tinnitus onset and COVID-19 diagnosis. Some of the studies they included in their analysis, reported tinnitus onset with COVID-19 diagnosis, one reported tinnitus onset after 13 days in intensive care unit, while one study reported tinnitus onset a week after leaving the intensive care unit. Only 2 patients reported complete resolution of tinnitus while others reported tinnitus even in the post infectious period [19].

Vertigo

Maslovara S. and Košec A. reported on two similar case studies. Two female patients (41 and 28 years old) developed short, intensive vertigo with nausea and vomiting more than a month after getting negative COVID-19 tests after two weeks of self-isolation and being COVID-19 positive. They both denied having any other symptoms. Dix-Hallpike test showed canalithiasis of the right posterior semicircular canal in both cases. Also, in both cases after 2 Epley maneuvers, both patients confirmed resolution of vertigo [20].

These two cases turn our focus to vestibular symptomatology that viral infection can cause. It is important to include vestibular neuritis (that is usually of viral origin) and benign paroxysmal positional vertigo in differential diagnosis. Benign paroxysmal positional vertigo accounts for 17.1% of vertigo cases in general population, while in the geriatric population prevalence goes to 50% [20, 21].

Almishaal A. A. and Alrushaidan A. A. created a questionnaire that was completed by 301 patients. Out of 301 patients, 65.9% were not hospitalized while 35.22% (103) were admitted to the intensive care unit. Out of all patients, 69.1% (208) reported at least one comorbidity. In the acute phase of infection, 11.63% were asymptomatic, while others had more symptoms. Most common symptoms were cough, elevated body temperature, malaise, loss of taste and smell; 21.93% reported auditory symptoms out of which 19 (6.31%) reported hearing loss, 30 (9.97%) tinnitus, 57 (18.94%) fullness in their ear, 6 (1.99%) difficulties of conversation in quiet environment, 10 (3.32%) difficulties in noisy environment. Even after 6 months, 11 (3.65%) patients reported presence of symptoms in milder forms [22].

Furthermore, 105 patients (34.88%) experienced vestibular symptoms, out of which 25 (8.31%) reported instability, 90 (29.9%) nausea, and 73 (24.25%) vertigo. In comparison to patients with auditory symptoms, patients with vestibular presentation were younger (33.35 ± 10.98 years). After 6 months, 12 patients (3.99%) still experienced vestibular symptoms. The authors established that the greatest predictors of auditory and vestibular difficulties were tiredness and malaise [22].

Olfactory and gustatory dysfunctions

Lechien JR. et al. conducted a multicentric European study including 417 patients out of which 357 (85.6%) had olfactory symptoms. There were 284 (79.6%) patients with anosmia and 73 (20.4%) with hyposmia. These symptoms occurred before (11.8%), after (65.4%) and at the same time as other symptoms (22.8%). Out of 247 patients that experienced regression of other symptoms and had a negative COVID-19 test, olfactory dysfunction persisted in 63% of cases. The patients were contacted 15 days after resolution of symptoms, not after a couple of months [10].

Gustatory dysfunctions were present in 342 patients (88.8%). In 78.9% of patients, sense of taste was disrupted, and in 21.1% it was completely gone. The loss of smell and taste were constant during infection in 72.8%, while in 23.4% it fluctuated. Out of all patients who reported loss of smell and taste only 3.8% showed correlation with nasal congestion therefore showing that congestion is a secondary mechanism in development of these symptoms. Gustatory dysfunction was not reported 15 days after resolution of other symptoms [10].

Agyeman AA. et al. performed a literature review about olfactory and gustatory symptoms related to COVID-19 with the aim to confirm the prevalence of these disorders. The study included 8,438 patients in a variety of published papers. The mean age was from 34 to 77 years and 58.7% (4,785 from 8150) were females. Out of 24 studies about olfactory disorders, 21% used objective methods of assessment while others relied on patients' self-reports. The prevalence ranged from 3.2% to 98.3% [23].

Gustatory dysfunctions were analyzed including 15 studies and 5,649 patients. Only 13% of studies used objective methods of assessment (UPSIT test, CCCRC test, sniff sticks), while the rest relied on patients' self-reports. The prevalence ranged from 5.6% to 62.7% [23].

Rhinorrhea

When it comes to pediatric population, Neha A. Patel reported that in children symptomatology and prevalence were different. Her results showed that out of 2,914 pediatric patients, 56% were boys, 79% did not have any comorbidities. Out of 21% children with comorbidities mostly presented with asthma, immunosuppression, and cardiovascular diseases. The study showed that 14.9% were completely asymptomatic. The most common symptom was cough (48%), elevated body temperature (47%) and pharyngitis (28.6%). Rhinorrhea was reported only in 13.7%, nausea and vomiting in 7.8% and diarrhea in 10.1%. This study shows that children really present with milder clinical symptoms than adults. Furthermore, this study shows that rhinorrhea is more common in children (13.7%) than in adults (2%) [12].

Pharyngitis

El-Anwar MW. et al. collected available data and included 1,773 COVID-19 positive patients with ENT symptoms. They reported that rhinorrhea was present in 38 patients (2.1%), nasal congestion in 72 patients (4.1%), olfactory dysfunction in 107 (6%), pharyingitis in 200 (11.3%), pharyngeal erythema in 98 (5.3%), tonsillitis in 23 (1.3%), headache in 189 (10.7%) and upper respiratory tract symptoms in 33 patients (1.9%). Based on available data, the authors concluded that the most common sings of infections were elevated temperature (1,303 patients, 73.5%), dry cough (1,080, 61%), productive cough (405, 22.8%), dyspnea (288, 16.2%), hemoptysis (10, 0.6%), chest pain (2, 0.1%), nausea/vomiting (69, 3.9%), constipation (2, 0.1%), diarrhea (75, 4.2%), malaise (484, 27.2%), and myalgia/arthralgia (185, 10.4%). Based on their findings, the most common ENT symptom is pharyngitis (reported in 11.3% of cases) [4].

Zimmermann P. and Curtis N. performed a literature review and analyzed 333 pediatric patients. They reported that 35% of children were asymptomatic, 42% had elevated body temperature, and pharyngitis was found in 30% of cases. They concluded that these symptoms were the most common clinical findings in children. This shows that children and adults have different clinical presentations [24].

Additionally, children are more susceptible to anemia, which is one of the risk factors for lower respiratory tract infections. Apart from that, neutrophilia and both high and low lymphocyte counts are common in pediatric population and are not so frequent in adults [25].

Discussion

The SARS-CoV-2 enters the human body and then starts replicating in human cells. After the first contact with the virus, it replicates inside the nasopharynx and that circle repeats until it reaches alveoli. Inside the lungs, it continues to replicate which leads to destruction of pulmonary tissue. Lung damage is associated with a risk for development of acute respiratory distress syndrome and also for virus spreading throughout the organism. It is spreading binding to erythrocytes and later binding to every cell with ACE2 receptor. The ACE2 receptors are found in vast types of tissues in the human organism. Computed tomography and MRI confirm that the virus has a tropism for the nervous system and that it is neuroinvasive which explains the existence of auditory, vestibular, gustatory, and olfactory symptoms [2–4].

The ENT symptoms are manifestations of COVID-19, but there are still not enough studies that would lead to knowing the absolute truth. Reasons for that are multifactorial. Firstly, pandemic caught all of us by surprise leading to great influx of patients which overwhelmed health systems all around the world. Great number of patients and emergencies caused less time for medical history taking and physical examination. Also, a lot of patients required emergency treatment due to their respiratory status which pushed back all non life threatening symptoms. In addition to all above mentioned, all around the world there were problems about resources, medical staff and medical equipment. On the other side, every research required all equipment to be sterilized between each patient which was complicated and time and resource consuming. With all that said, it is understandable that non urgent symptoms were disregarded at the peak of the pandemic. In addition, at the time of writing this article, there was no worldwide consensus agreed upon treatment of COVID-19 patients. Steroid use during infection is also a great problem, since it weakens the immune system and changes the response of a human body to virus [1, 3].

Most researchers agree that the most common SARS-CoV-2 infection symptoms are elevated body temperature, diarrhea, cough, tiredness, malaise, myalgia, and arthralgia. Also, it is a fact that patients present with ENT symptoms after COVID-19. The existence of these symptoms points to neural tropism of SARS-CoV-2 in contrast to SARS-CoV and Middle East respiratory syndrome coronavirus [4].

There is no way to be certain about the risk factors for ENT manifestations and which symptom is the most common just yet. According to El-Anwar MW. et al., the most frequent ENT symptom is pharyngitis, while according to Fancello V, Hatzopoulos S, and Corazzi V, it is sensorineural hearing loss. Nevertheless, ENT manifestations of COVID-19 are real and reported. It is now time to globally agree on how to treat patients with COVID-19, then to document data regarding ENT symptoms with aim to get unanimous prevalence, risk factors, and most importantly, a cure for them [4, 19].

Thus, the hypotheses were confirmed:

3. COVID-19 affects the otorhinolaryngology region;

4. COVID-19 can cause both short-term and long-term otorhinolaryngology consequences.

The advantage of this paper is that it shows that there are still not enough data and knowledge about ENT symptoms of COVID-19 and it turns the spotlight on the missing data in hope that it will lead to more research.

The limitation of the paper is that, since there are still not enough data, studies from around different parts of the world were compared, which can mean that data differ, because there was no one accepted consensus when it comes to treatment of COVID-19 worldwide. There is a possibility that excessive antimicrobials and steroids were used, which may impact the function of ENT organs.

Conclusion

Severe acute respiratory syndrome coronavirus 2 is a new strain of coronavirus which causes primarily respiratory infections, but researchers have confirmed its systemic effect.

Due to emergency situation that we were part of, healthcare systems around the world were put under tremendous pressure. The focus was on life threatening symptoms. When the pandemic slowed down,

more and more patients reported symptoms atypical for the infection, such as ear, nose, and throat symptoms. It was becoming clear that with severe acute respiratory syndrome coronavirus 2 a much wider variety of symptoms became real, not just respiratory.

It is shown that auditory, vestibular and sensory related symptoms are a part of coronavirus disease 2019 clinical presentation. The fact is, coronavirus disease 2019 affects not only the respiratory tract, and it may do it slowly, without raising too much attention during the infection or even after. Also, it can leave behind subclinical damage that patients may be unaware of, but that can make them more susceptible to damage later on in life, such as differences in tone audiometry and transient evoked otoacoustic emission in asymptomatic patients and healthy individuals.

This paper shows that otorhinolaryngology manifestations are part of the coronavirus disease 2019, even though not all questions are answered. The aim of this paper was to show discrepancies in knowledge and literature regarding this subject and raise interest for future discoveries.

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