

# INVESTIGATION OF THE TEMPORAL BONE INVOLMENT IN COVID-19

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June 15, 2020

## Abstract

**Objective:** To investigate temporal bone findings in COVID-19 **Design:** Retrospective study **Settings:** Using the database of our tertiary pandemic hospital, patients with COVID-19 infection with a positive PCR test and temporal bone tomography imaging were evaluated. **Participants:** 42 PCR positive COVID-19 patients with temporal bone imaging. **Main outcome measures:** A grading system was created to evaluate effusion in the middle ear and mastoid air cells. Also any specific sign in temporal bone imaging. **Results:** Patients were divided into two groups according to their chest CT findings. Group 1 had specific chest CT findings and included 26 patients, group 2 had no findings in chest CT and included 16 patients. No obvious temporal bone involvement was observed in any of the patients. Temporal bone imaging findings were compared according to a grading system and there was no difference between the groups ( $p=0,50$ ). **Conclusion:** The SARS-CoV-2 does not affect the temporal bone. There was no sign of effusion in mastoid air cells or the middle ear or any specific sign in the temporal bone in our study group.

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**Conclusion:** The SARS-CoV-2 does not effect the temporal bone. There was no sign of effusion in mastoid air cells or middle ear or any specific sign in temporal bone in our study group.

**Keywords:** COVID-19, temporal bone, SARS-CoV-2, mastoid, middle ear

## INTRODUCTION:

SARS-CoV-2; a novel coronavirus; was identified as the cause of anof acute respiratory disease in Wuhan, China. The number of cases had increased and outbreak spread across the worldwide. World Health Organisation (WHO) was named this new disease as COVID-19 (corona virus disease 2019). COVID-19was declaredpandemic byWHO in March 2020.

There is a lot of unknown about the disease even symptoms are not certain. Fever, cough and shortness of the breath is observed frequently as a result of pneumonia. Disease generally settle in lungs but, the nose and nasopharynx have been shown to be reservoirs for high concentrations of theSARS-CoV-2 virus. <sup>1,2</sup>

Middle ear and mastoid air cell system is covered by respiratory mucosa. Airway mucosa is involved in COVID-19 but it is not known if the respiratory mucosa lining eustachian tube, middle ear and mastoid air system is involved but might be contaminated. <sup>3,4</sup>

Rhinovirus, respiratory syncytial virus and coronavirus as respiratory viruses have been implicated as potential agents of acute otitis media. Acute otitis media is an inflammatory process of the middle ear associated with an effusion. Middle ear and mastoid air cell inflammation result effusion and effusion can be detected by computed tomography. <sup>5,6,7</sup>

Viral infections can cause congenital or acquired, unilateral or bilateral hearing loss. They can directly damage inner ear structures, can stimulate inflammatory responses and cause inner ear damage or can result secondary bacterial or fungal infection; leading to hearingloss. Generally viruses cause sensorineural hearing loss but conductive and mixed hearing losses can be seen. In a study it was shown that hair cells of the cochlea can be injured in COVID-19. But the mechanism is unclear. <sup>8,9,10,11</sup>

There is no information about effect of SARS-CoV-2 virus on ear. Does the virus effect mastoid cells and middle ear like other coronaviruses? Does it cause otitis media or effusion? Is there any radiological finding in mastoid or middle ear or cochlea?

In our study we investigated the temporal imaging of the COVID-19 positive patients.

## MATERIAL AND METHODS:

This was a retrospective observational study. The study group comprised of 42 patients. The patients with COVID-19 infection with a positive PCR test and temporal computed tomography (CT) were evaluated. 42 subjects were included through total 789 patients due to the selection of those who has temporal bone imaging. Patients had temporal computed tomography (CT) scans, paranasal CT axial scans or cranial CT scans. All patients had active COVID-19 infection, imaging including temporal bone during hospitalization, normal tympanic membrane and symptoms which lead to imaging like headache or fullness around eyes.

The patients with a history of chronic otitis media, ear surgery, active other infection besides COVID-19, hearing loss, smoker or vertigo are excluded from the study. Grading system was used to evaluate effusion in imagines. These score is applied as for left or right mastoid cells and left or right middle ear separately 0= no inflammation, 1= partial inflammation and 2= %100 inflammation. Maximum total score was8.

The patients divided into two groups due to findings in chest (CT) findings. Group 1 (27 patients) had typical radiological signs for COVID-19 and group 2 (15 patients) had negative no signs of COVID-19. Groups was compared for grading scores.

### Statistical analysis

Data were analyzed using the SPSS version 21.0 software program (Statistical Package for Social Sciences v.21, IBM, Chicago, IL). For comparison of group 1 and group 2 in terms of grading score, a Paired simple t-test was used.  $P < 0.05$  was considered statistically significant.

### Ethical Consideration

Because this research includes human subjects, ethical approval was taken from the Ministry of Health and the local ethical committee. All patient were informed about the study and informed consent was obtained.

## RESULTS:

A total of 42 hospitalized patients who were confirmed positive for COVID-19 and had a temporal computed tomography (CT) scans, paranasal CT axial scans or cranial CT scans were included to this study.

The mean age was 45,61 (standard deviation  $\pm$  19.60; min–max 20–83 years). Of the 42 patients, 26 (61.9%) were male and 16 (38.1%) were female. Patients were divided into two groups according to their chest CT findings. Group 1 had specific chest CT findings and included 26 patients, group 2 had no findings in chest CT and included 16 patients. There were no difference in the female/male proportion between groups ( $p$ : 0.636). There was no difference between the groups for comorbid diseases (Table 1) and onset symptoms of disease (Table 2). No obvious mastoid air cells and middle ear cavity involvement was observed in any of the patients. Temporal imaging findings were compared according to our grading system and there were no difference between the groups ( $p=0,50$ ) (Table 3).

## DISCUSSION:

SARS-CoV-2 virus found in high concentrations in nose and nasopharynx. Nasopharynx has close relation with mastoid cells and middle ear. Airway mucosa is involved in COVID-19. Middle ear, eustachian tube and mastoid cells are covered by airway mucosa which is involved in COVID-19. Because of these findings ear might be contaminated but there is no evidence.<sup>1,12,13</sup>

It is known that coronaviruses has role in acute otitis media and upper respiratory tract infections. Effusion often seen in acute otitis media and upper respiratory tract infections. This effusion can be seen in radiological examination of the middle ear and mastiod cells. There is a unknown about SARS-CoV-2's middle ear involvement. Virus might cause otitis media like other coronaviruses and this can be seen in radiological imaging.<sup>6,13,14</sup>

Evaluating hearing loss pathogenesis of COVID-19 has getting attention and needs more studies and evidence. Middle ear and mastoid cavity may be an important route of infection. Virus may effect middle ear, inner ear or mastoid cells and cause hearing loss which may be detected by temporal bone imaging. But there is no study about temporal bone imaging of COVID-19.

Untill now there is no specific treatment for COVID-19, so hand hygiene, social distancing, quarantine and wearing face masks are the main points of the preventing the spread of the disease.<sup>15,16,17</sup>

COVID-19 pneumonia has typical radiological signs in chest CT like unilateral or bilateral ground-glass opacities and consolidation with or without vascular enlargement, interlobular septal thickening, and air bronchogram sign.<sup>18</sup>

In our study we found no specific involment in temporal bone. No typical CT findings and interestingly no effusion in mastoid cells or middle ear. All patients had normal healthy temporal CT. There were no difference between two groups according to grading with or without typical signs of COVID-19 in chest CT.

Our study is the first study which investigate the temporal CT in COVID-19. The signs of acute otitis and/or effusion and typical CT findings in temporal bone were investigated.

Limitations of our study were retrospective design, small number of the study groups and lack of hearing test of the patients. Because the COVID-19 is very contagious we could not design a prospective study, which performs temporal bone tomography and hearing test together to all of the patients.

We examined the tympanic membranes of the all patients but we did not perform hearing test and tympanometric test to patients. After evaluating the mastoid cells, middle ear and inner ear temporal bone findings we found that the virus has no effect on temporal bone with or without chest CT findings. It can be suggested that hearing loss in COVID-19 is not because of the effusion in ear, acute otitis or any involment that can

be diagnosed via temporal CT with these findings. Further studies with larger populations, detailed hearing tests, cochlear and inner ear evaluation will be useful to evaluate the etiology of hearing loss in COVID-19.

## CONCLUSION:

There was no middle ear or mastoid involvement also no effusion seen in COVID-19. According to our findings SARS-CoV-2 doesn't cause any temporal bone radiological changes.

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