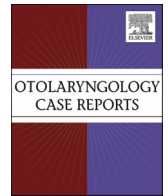




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# Undetectable viral load within the mastoid during cochlear implantation in a patient with COVID-19

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## Introduction

This study was considered exempt upon review by Vanderbilt IRB.

Since December of 2019, the ongoing global pandemic caused by the novel coronavirus (SARS-CoV-2) and associated coronavirus disease-2019 (COVID-19) has had wide-reaching effects on the American healthcare system and our ability to deliver routine surgical care. There is ample evidence that the virus is present in high quantities within the nasopharynx and oropharynx and that exposure to high viral loads, especially in the form of aerosol-generating procedures, can risk viral transmission to healthcare workers [1]. As the middle ear is in continuity with the nasopharynx, it is presumed that the middle ear may contain viral particles which can be aerosolized during otologic procedures. This is particularly true with regards to procedures that require the use of a drill, which has been shown to cause significant aerosolization of bone, tissues, and middle ear fluid [2]. Therefore, routine otologic surgeries including cochlear implantation that result in aerosolization via drilling have been limited or postponed in COVID-19-positive patients and patients with unknown viral status. The American Neurotology Society, American Otological Society, and American Academy of Otolaryngology – Head and Neck Surgery have recommended caution with aerosol generating procedures of the middle ear that have the potential to expose health care workers to dangerous levels of the virus [3].

Despite these concerns, there is very little evidence demonstrating the presence and natural progression of SARS-CoV-2 within the middle ear to guide recommendations. We present a case of a 12-month-old female who persistently tested positive for COVID-19 who ultimately

underwent bilateral cochlear implantation. Bilateral mastoid cavities were sampled intraoperatively and found to be negative for the presence of SARS-CoV-2 despite positive viral load sampled within the nasopharynx.

## Case report

A 12-month-old female with progressive bilateral profound sensorineural hearing loss was scheduled for bilateral cochlear implantation, but tested positive for COVID-19 on routine pre-operative asymptomatic screening. Her surgery was delayed for 6 weeks according to institutional policy at that time. She remained asymptomatic during this period. However, a repeat nasopharyngeal swab was again positive at 6 weeks. After thorough discussion between the operative team and patient family, the decision was made to proceed with surgery with appropriate precautions for aerosol-generating procedures in a COVID-19-positive patient.

Intraoperatively, the bilateral mastoid cavities and nasopharynx were swabbed. Quantitative reverse transcription polymerase chain reaction (RT-qPCR) was performed on the samples according to US Centers for Disease Control and Vanderbilt University Medical Center protocols (primers and controls obtained from Integrated DNA Technologies, USA). Nasopharyngeal swab was mildly positive for the presence of viral load on RT-qPCR. The virus was not detected in either mastoid. Quantitative data is provided in Fig. 1 and Table 1.

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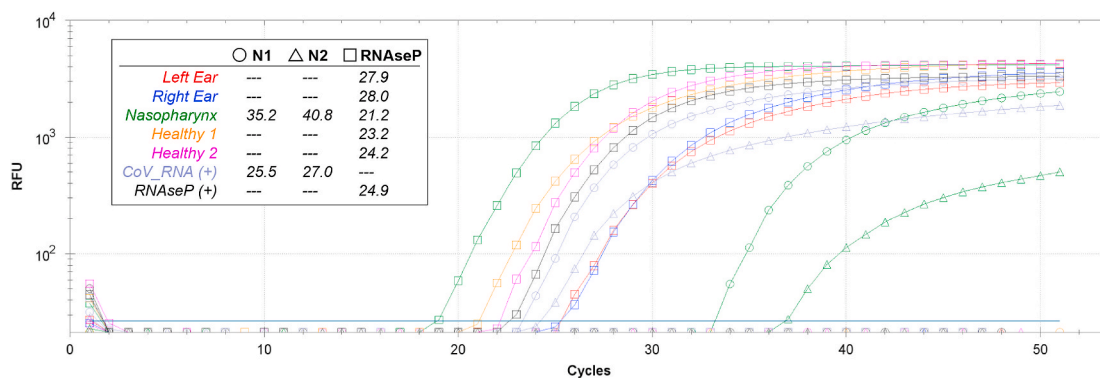
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**Fig. 1.** Quantitative PCR Amplification Plot (N1 = circle, N2 = triangle, RNaseP = square). Samples plotted as relative fluorescence units (RFU). Cycle threshold values plotted for each sample and target.

**Table 1**  
Pathology specimen cycle threshold values.

	N1 (Run 1)	N2 (Run 2)	RNaseP
Left Ear	–	–	27.85
Right Ear	–	–	28.01
Nasopharynx	35.24	40.80	21.24
Negative Control	–	–	–
Positive Control	25.52	26.98	–
RNaseP Positive Control	–	–	24.94

**Discussion**

As the COVID-19 pandemic persists, the problem of delaying elective procedures including cochlear implantation and other otologic surgery becomes increasingly complex. There is a significant concern for risk to healthcare workers during aerosol generating procedures, including mastoidectomy. However, prolonged treatment delays can lead to negative long-term outcomes for children with hearing loss during critical periods of language development. Careful thought should be taken with regards to how long to delay time-sensitive surgery in these patients.

Other respiratory viruses have been well-documented within the middle ear space [4]. However, due to the known risks of aerosol generating procedures in COVID-19 positive patients, most cases involving mastoidectomy are postponed until patients have cleared the disease. Therefore, studies on the presence or absence of COVID-19 viral load in the middle ear and mastoid of known COVID-19-positive patients have been extremely limited. Wanna et al. [5] reported on mastoid viral testing performed during mastoid cavity debridement in a patient who had previously been hospitalized for COVID-19-related illness. However, at the time of the procedure both mastoid and nasopharyngeal swabs were negative for the presence of viral load. These results are difficult to extrapolate for management of persistently positive patients, as in this case. Frazier et al. quantified COVID-19 viral load within the middle ear and mastoid of three patients who died with COVID-19. Persistent COVID-19 positivity was confirmed post-mortem, but nasopharyngeal quantitative data was not reported. This was the first study to definitively demonstrate the presence of COVID-19 viral load within the middle ear. However, this study was limited by lack of information about the time course of the disease in the individual subjects as well as the post-mortem nature of the study. Here we report the first documented instance of concomitant nasopharyngeal and mastoid sampling for COVID-19 in a patient with persistent perioperative COVID-19 positivity in the nasopharynx.

**Conclusion**

In this case, despite a persistently positive COVID-19 nasopharyngeal viral load demonstrated pre-operatively and again intraoperatively, there was no viral load in the mastoid. We conclude that in select cases, it may be safe to perform cochlear implantation and other routine otologic surgery for patients who persistently test positive for COVID-19 after an adequate waiting period. Further research is needed to determine the time course of viral load within the mastoid in patients who are persistently positive for COVID-19.

**Ethical statement**

This study was considered exempt upon review by Vanderbilt IRB.

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**Author statement**

Kyle S. Kimura, MD: primary author, concept, data collection, manuscript writing/editing.  
 Miriam R. Smetak, MD, MS: manuscript writing/editing.  
 Michael H. Freeman, MD: manuscript writing/editing.  
 Christopher T. Wooten, MD: senior author, primary surgeon.

**Declaration of competing interest**

The authors declare that they have no relevant conflicts of interest.

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**Appendix A. Supplementary data**

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.xocr.2021.100273>.

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