

# Safety and Impact of Nasal Lavages During Viral Infections Such as SARS-CoV-2

Ear, Nose & Throat Journal  
2021, Vol. 100(2S) 188S–191S  
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DOI: 10.1177/0145561320950491  
journals.sagepub.com/home/ear



Thomas Radulesco, MD, PhD, MS<sup>1,2</sup> , Jerome R. Lechien, MD, PhD, MS<sup>1,3,4</sup> ,  
Sven Saussez, MD, PhD, MS<sup>3</sup> , Claire Hopkins, MD, PhD<sup>5</sup>,  
and Justin Michel, MD, PhD, MS<sup>1,2</sup>

## Keywords

nasal lavages, SARS-CoV-2, viruses, viral load, coronavirus infections, pandemics

Much has been stated about the potential risks of nasal lavages (NL) during the coronavirus disease 2019 (COVID-19) pandemic for COVID-19 patients and surrounding people. Several otolaryngological societies recommended to limit NL, supposing it may be associated with viral spread to lower airway.<sup>1</sup> On the contrary, recent studies suggested that NL may be beneficial in upper viral respiratory infectious diseases. In order to take stock of this issue, we conducted a short literature review to address 4 main questions:

## What Are the Potential Benefits of NL to COVID-19 Patients?

**Beneficial effects on nasal mucosal.** Ions, pH and tonicity may influence epithelial cell function in vitro. Isotonic solutions with slightly alkaline pH optimize trophic and functional recovery of the respiratory epithelium.<sup>2</sup> In chronic rhinosinusitis, saline solutions improve mucociliary clearance<sup>3</sup> without altering commensal bacteria.<sup>4</sup> These actions may aid recovery of the nasal epithelium after viral injury and reduce associated symptoms of rhinitis.

**Direct antiviral effects.** Recently, Ramalingam et al reported that antiviral activity against viral infections can be augmented by increasing availability of NaCl.<sup>5</sup> Nasal lavages containing carrageenans, which are natural emulsifiers derived from red seaweed, seemed to reduce the Influenza A viral load in nasal secretions and positive effects on mucosal barrier function.<sup>6,7</sup> Hendley and Gwaltney reported lower virus concentrations after saline NL in *rhinovirus* infections.<sup>8</sup> Regarding severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Carrouel et al found the use of a mouth rinses with local nasal applications that contain  $\beta$ -cyclodextrins combined with flavonoids agents reduce the viral load of saliva and nasopharyngeal microbiota, including potential SARS-CoV-2 carriage.<sup>9</sup>

The use of copper-enhanced NL seems to be efficient to decrease viral spread and contamination, especially regarding SARS-CoV-2.<sup>10,11</sup> Human coronavirus 229E was rapidly inactivated on a range of copper alloys at low copper concentration, suggesting a specific antiviral effect.<sup>12,13</sup> In fact, exposure to copper destroyed the viral genomes and irreversibly affected virus morphology, including disintegration of envelope and dispersal of surface spikes.<sup>14</sup> Copper also inactivates SARS coronavirus, bacteria, and yeast in the air after 20 minutes of exposure.<sup>15</sup> A recent study has proposed that the combination of copper, N-acetylcysteine, colchicine, and nitric oxide with antiviral agents may be a treatment option for SARS-CoV-2-positive patients.<sup>16</sup>

**Washing and reduction of viral load in enhancing recovery.** Computational fluid dynamics studies demonstrate that all nasal regions are reached when using a head tilt position of 45 °C forward for NL,<sup>17</sup> especially with large-volume irrigations,<sup>18</sup>

<sup>1</sup> COVID-19 Task Force of the Young-Otolaryngologists of the International Federations of Otorhinolaryngological Societies (YO-IFOS), Marseille, France

<sup>2</sup> Department of Otorhinolaryngology–Head and Neck Surgery, Aix Marseille University, APHM, IUSTI, La Conception University Hospital, Marseille, France

<sup>3</sup> Department of Human Anatomy and Experimental Oncology, Faculty of Medicine, UMONS Research Institute for Health Sciences and Technology, University of Mons (UMons), Mons, Belgium

<sup>4</sup> Department of Otolaryngology–Head & Neck Surgery, Foch Hospital, School of Medicine, UFR Simone Veil, Université Versailles Saint-Quentin-en-Yvelines (Paris Saclay University), Paris, France

<sup>5</sup> King's College, London

Received: July 20, 2020; revised: July 23, 2020; accepted: July 27, 2020

## Corresponding Author:

Thomas Radulesco, MD, PhD, MS, Department of Otorhinolaryngology–Head and Neck Surgery, La Conception University Hospital, 147 Bd Baille, 13005 Marseille, France.

Email: thomas.radulesco@ap-hm.fr



suggesting good mechanical efficiency of NL in washing the nose.

Nasal mucosa have high viral loads and include cells expressing proteases responsible for virus entry (such as angiotensin-converting enzyme 2 and TMPRSS2 for SARS-CoV-2),<sup>19,20</sup> The upper airway has shown to be a reservoir for descending bacterial or viral infection to the lung.<sup>21</sup> The nose can be considered as a site of virus replication, accumulation, and human body entry.<sup>22</sup> Interestingly, NL tends to decrease nasal viral loads and, therefore, could reduce systemic or bronchopulmonary dissemination.<sup>8</sup> Nasal lavages are commonly used treatments in the upper respiratory tract infections and can decrease duration of illness in common cold.<sup>3,23,24</sup>

Given the potential benefits summarized above, nasal saline irrigation may enhance recovery in patients known to be infected with COVID-19. Patients are currently being recruited to a randomized controlled trial to evaluate the benefits to COVID-19 patients, although no results are yet available.<sup>25</sup>

### **What Are the Potential Benefits of NL to Personal Contacts/Healthcare Workers Caring for COVID-19 Patients?**

When properly performed, NL have shown to decrease household transmission in other viral disease.<sup>26</sup> The potential direct antiviral actions and reduction in viral load have led to proposals that use in patients with COVID-19 may reduce risk of nosocomial transmission. It has been proposed that regular use of NL in COVID-19 patients may reduce risk of transmission to household contacts or Healthcare Workers (HCWs), particularly if used before aerosol-generating procedures (AGPs).<sup>27</sup> It has also been suggested that HCWs involved in the care of COVID-19 patients could use NL with povidone-iodine before and after patient contact, particularly for high-risk procedures.<sup>27</sup>

In asking a patient or currently healthy HCW to perform an intervention aimed at protecting others, it is important to discuss potential side effects of the intervention.

### **What Are the Potential Harms of NL to Patients With COVID-19?**

**Risk of toxicity.** Although nasal saline irrigation has been shown to have no detrimental effects on olfaction, additives to NL solutions may cause anosmia, which would be difficult to detect in trials of COVID-19 patients, where olfactory dysfunction is highly prevalent. A number of agents have been shown to cause anosmia if delivered intranasally, such as zinc gluconate and sinus surfactant solutions.<sup>28</sup> Although the safety of povidone-iodine has been evaluated in vitro, at concentrations above 5% it is known to be ciliotoxic.<sup>29</sup> Its use in mouthwash and nasal spray in COVID-19-infected patients prior to dental and other AGPs has been widely promoted in the absence of rigorous in vivo evaluation.<sup>7,30</sup>

**Risk of bronchopulmonary dissemination.** To date, no study suggested that NL is associated with lower respiratory disorders.

### **What Are the Potential Harms of NL to Personal Contacts/HCWs Caring For COVID-19 Patients?**

**Risk of droplet spread and surface contamination.** Irrigation is likely to generate droplets potentially carrying viruses. Sinus irrigation devices, mostly composed by plastic, can harbor viruses for hours: van Doremalen et al showed that SARS-CoV-2 is very stable on plastic and remains viable up to 72 hours.<sup>12</sup> As the COVID-19 status of most of patients using NL is unknown, specific measures should be undertaken to protect personal contacts or HCWs.<sup>31</sup>

#### **Protective measures.**

- Clean the inside and outside of the NL device thoroughly with soap and water. For a deeper clean of components of the device that come into contact with the nose, clean with 70% isopropyl alcohol or concentrated white vinegar, rinse, and then leave to it dry before next use. Some commercial products may be suitable for sterilization in the microwave but must be replaced if there is any sign of degradation of plastic components.
- Self-irrigation is important, avoiding viral exposure to others.
- Ventilate the room: being able to remain suspended in the air, small droplets were shown to permit SARS-CoV-2 detection in ambient air for 3 hours.<sup>12</sup> Guidelines on air exchanges per hour required for airborne contaminant removal have been edited by CDC.<sup>32</sup>
- Perform household cleaning, disinfection of high-touch surfaces, and hand hygiene. The United States Environmental Protection Agency and the CDC (Center for Disease Control and Prevention) published a list of recommended household disinfectants.<sup>33</sup>

Consistent with current guidance, these measures will help to limit viral spreading.

## **Conclusion**

Taken together, these data suggest that NL can be continued during viral infection when respecting strict conditions of use and hygienic measures. Moreover, properly performed, large-volume NL with specific composition such as copper or povidone-iodine could limit viral contamination and spreading. In vitro, in vivo, and in silico studies must confirm these data.

#### **Authors' Note**

T.R. and J.R.L. are joint first authors. C.H. and J.M. are joint senior authors.

#### **Acknowledgments**

To Pr Vincent Couloigner and Dr Philippe Contencin.


## Declaration of Conflicting Interests


The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.


## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## ORCID iDs

Thomas Radulesco  <https://orcid.org/0000-0002-5939-5372>

Jerome R. Lechien  <https://orcid.org/0000-0002-0845-0845>

Sven Saussez  <https://orcid.org/0000-0002-3655-1854>

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