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Potential Influence of Olfactory, Gustatory, and Pharyngolaryngeal Sensory Dysfunctions on Swallowing Physiology in COVID-19

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Abstract

Persistent smell and taste disorders have been reported as some of the most common symptoms after COVID-19 (coronavirus disease 2019). Sensory, olfactory, and gustatory functions perform an important role in the initiation and modulation of oropharyngeal swallow biomechanics and salivation as well as in mealtime enjoyment and appetite. Yet, the details of this interaction remain relatively unknown in patients who are infected with and recovering from COVID-19. In this commentary, we discuss the possible impacts of SARS-CoV-2 on the central and peripheral nervous system and consider the pathophysiology of olfactory, gustatory, and pharyngolaryngeal sensory deficits and its influence on deglutition, describing hypotheses and offering guidance for future research.

Keywords

COVID-19, SARS-CoV-2, smell, taste, sensory, deglutition disorders

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The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) interacts with ACE2 (angiotensin-converting enzyme 2) and TMPRSS2 (transmembrane protease serine 2) proteins, which are present in cells lining the oral cavity, tongue, and olfactory epithelium, resulting in loss of olfactory (anosmia) and gustatory (ageusia) sensations.[1,2] The pathophysiology of these sensory alterations remains in debate. Several authors consider that changes in olfactory and gustatory functions are associated with damage and/or inflammation of the olfactory and gustatory epithelium.[1] Besides involving damage to the nasal epithelium, these sensory alterations may be expressions of nerve damage, olfactory bulb vascular lesions,[1,3] or even of lesions in the central nervous system (CNS).[1,4] ACE2 and TMPRSS2 proteins are present in other regions of the head and neck,[2] including critical anatomic regions for swallowing function, such as the nasopharynx, oropharynx, hypopharynx,[2] larynx, and vocal folds.[5] It is not clear whether SARS-CoV-2 can cause sensory dysfunction in these other swallowing regions in the same way as the effects on the nasal and oral cavity. Alterations to taste, smell, and pharyngolaryngeal sensory function may negatively affect swallowing function, making patients with coronavirus disease 2019 (COVID-19) more vulnerable to dysphagia and respiratory infections.

Studies suggest that taste, smell, and pharyngolaryngeal sensory functions are critical for a healthy swallowing function, with roles in initiation and modulation of the swallow sequence.[6-8] The peripheral sensors of the aerodigestive pathways responsible for smell and taste facilitate bolus preparation and prepare the oropharynx for the act of swallowing, with influences on swallowing efficiency, salivary flow, and pleasure.[6,8]

Pharyngolaryngeal sensitivity modifications, absence of gag reflex, silent aspiration, and impaired pharyngeal constriction have been reported in a patient with olfactory and gustatory alterations and dysphagia related to COVID-19.[9] These findings suggest possible neurologic impairments that may interfere in swallowing,[9] with effect on not only taste

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and smell but also the sensorimotor function of the pharynx and larynx, which may compromise airway protection and deglutition safety.[9] Reduced laryngeal sensation, for example, may result in an absence of cough, ultimately leading to airway invasion (ie, silent aspiration).[7]

Sensory nerve endings related to smell (eg, olfactory bulb) are thought to be used by several viruses as a shortcut to the CNS.[1] Olfactory bulb vascular lesions[3] and hypoactivity in the orbitofrontal cortex were recently evidenced in neuroimaging tests in patients with COVID-19.[4] This evidence led to consideration of coronavirus as a potential neurologic invader, able to affect brain regions related to taste, smell, and perhaps swallowing. A proper understanding of the pathophysiology of sensory dysfunctions and the etiology of dysphagia in COVID-19 may aid rehabilitation and prognosis formulation. In addition, COVID-19 has been associated with muscle weakness and elevated serum creatine kinase levels,[10] and this myopathy seen in skeletal muscles may affect the muscles of swallowing. Understanding how the virus behaves in the skeletal muscle tissues of the head and neck (eg, suprahyoid muscles) and how it can affect muscle strength and function will be key to planning swallowing rehabilitation. For now, we believe that a thorough evaluation of the sensory alterations and a treatment that includes olfactory, gustatory, and pharyngeal stimulation, as an integral part of muscle-strengthening programs, have the potential to improve oropharyngeal dysphagia outcomes.[6-8]

Perspectives for Advancing Research, Scientific Evidence, and Clinical Practice

The theory that the peripheral and central invasive ability of SARS-CoV-2 may result in interactions among anosmia, ageusia, pharyngolaryngeal sensory function, and deglutition needs comprehensive testing. To achieve this, we propose investigating how SARS-CoV-2 can use taste and smell sensory pathways to reach the CNS to determine whether, ageusia, and anosmia are evidence of neurologic alterations. Clinicians need to understand how SARS-CoV-2 can affect pharyngeal sensory-motor function and the influence of changes in taste, smell, and pharyngolaryngeal sensation caused by COVID-19 on swallowing. Peripheral and central neurologic examinations, with an instrumental evaluation of deglutition, are critical to facilitate swallowing rehabilitation. We need to explore new approaches to sensory stimulation for acute and chronic sensory dysfunction caused by COVID-19.

Conclusions

The effects and impact of the SARS-CoV-2 virus in deglutition are unclear. A better understanding of how olfactory and gustatory alterations and the impairments on pharyngolaryngeal sensation could modify deglutition may facilitate the interpretation of dysphagia clinical profiles in patients with COVID-19. In turn, this understanding could facilitate the creation of better tools for evaluation, diagnosis, and rehabilitation for these disorders.

Author Contributions

José Vergara, main author of the manuscript, concept and design, conducting the analysis and critical interpretation of the literature, writing and final review. **Camila Lirani-Silva**, contributing author, writing of the manuscript, analysis and interpretation of the literature, final approval. **Martin B. Brodsky**, contributing author, critical revision of the manuscript, interpretation, writing, final approval. **Anna Miles**, contributing author, critical revision of the manuscript, interpretation, writing, final approval. **Pere Clavé**, contributing author, critical review of the manuscript, interpretation, final approval. **Weslania Nascimento**, contributing author, critical review of the manuscript and final approval. **Lúcia Figueiredo Mourão**, senior author, conducting the analysis and critical interpretation of the literature, writing and final revision.

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