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**Clinical Note**

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# Magnetic resonance imaging of sudden-onset anosmia in COVID-19 infection

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Novel coronavirus was initially reported in Wuhan, China, as a mild-to-severe acute respiratory syndrome. It seems that post-viral anosmia/hyposmia is a frequent clinical presentation of coronavirus disease 2019 (COVID-19) infection and several reports are about the role of imaging in olfactory dysfunction induced by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since post-viral mucosal congestion and rhinorrhea can alter smelling ability, COVID-19-induced anosmia can occur in absence of nasal obstruction. For investigating the probability of sensorineural olfactory loss in COVID-19 infection, we performed magnetic resonance imaging (MRI) to assess olfactory bulbs and tracts.

A 31-year-old man presented with low-grade fever and myalgia for four days. At fifth day, myalgia relieved, and acute-onset anosmia started without nasal obstruction and congestion. He had no headache, cough, or rhinorrhea. The patient had no past psychiatric and neurological problem. There was no history of alcohol intake or cigarette smoking. He underwent polymerase chain reaction (PCR) test, confirming COVID-19 infection on 7$^{th}$ day.

On low-dose chest computer tomographic (CT) imaging, bilateral small peripheral ground glass opacities were observed in lower lobes (Figure 1). MRI of brain using routine [axial T1, axial, coronal, and sagittal T2, axial fluid attenuation inversion recovery (FLAIR), and diffusion weighted imaging (DWI)] sequences and also, olfactory bulb MRI was performed without contrast (1.5 T scanner Avanto, Siemens Medical Solutions). During MRI exam, only one staff was in direct contact with the patient who used personnel protective equipment. Olfactory bulb was investigated by non-echo planar imaging (EPI)-DWI [repetition time (TR): 2000, echo time (TE): 119, b-value: 800, flip angle: 150] and thin section sampling perfection with application- optimized contrasts using different flip angle evolution (SPACE) sequences (TR: 1200, TE: 265; flip angle: 150).

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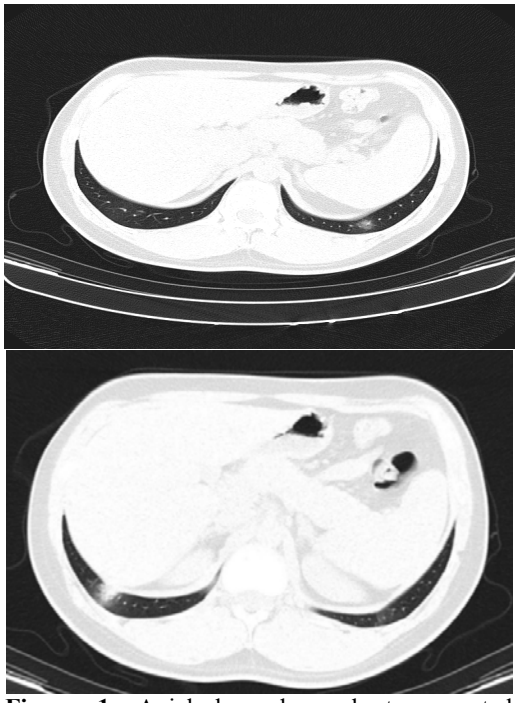

**Figure 1.** Axial low dose chest computed tomography (CT) scan without contrast injection shows bilateral small ground glass opacities.

Brain MRI was unremarkable. Despite his loss of smell, olfactory bulb MRI exam showed bilateral normal volume, morphology, and signal intensity olfactory bulbs without diffusion restriction and also, normal olfactory clefts (Figures 2 and 3). On follow up exam, fever and myalgia relieved; and his smelling ability began to improve gradually from 11th day, but has not fully recovered yet.

Post-viral anosmia is one of the most common reasons of impaired olfactory function.[1,2] It can be due to both conductive and sensorineural impairment. In contrast with nasal obstruction that resolves within mean time of three days, neural damage takes more to heal.[3] The recovery time in COVID-19-induced anosmia is shorter than other viruses that can cause post-viral olfactory loss (POL); including Epstein-Barr virus, parainfluenza and rhinovirus.[1] Pathogenesis of POL in SARS-CoV-2 infection is unclear. Respiratory epithelium is the primary site of COVID-19 attachment to its entry points including transmembrane serine protease 2 and angiotensin converting enzyme 2 receptors, which may explain POL in affected patients.[1,4] The olfactory data processing is performed in olfactory bulbs, and transferred by olfactory tract to primary olfactory cortex of temporal lobe.[1]

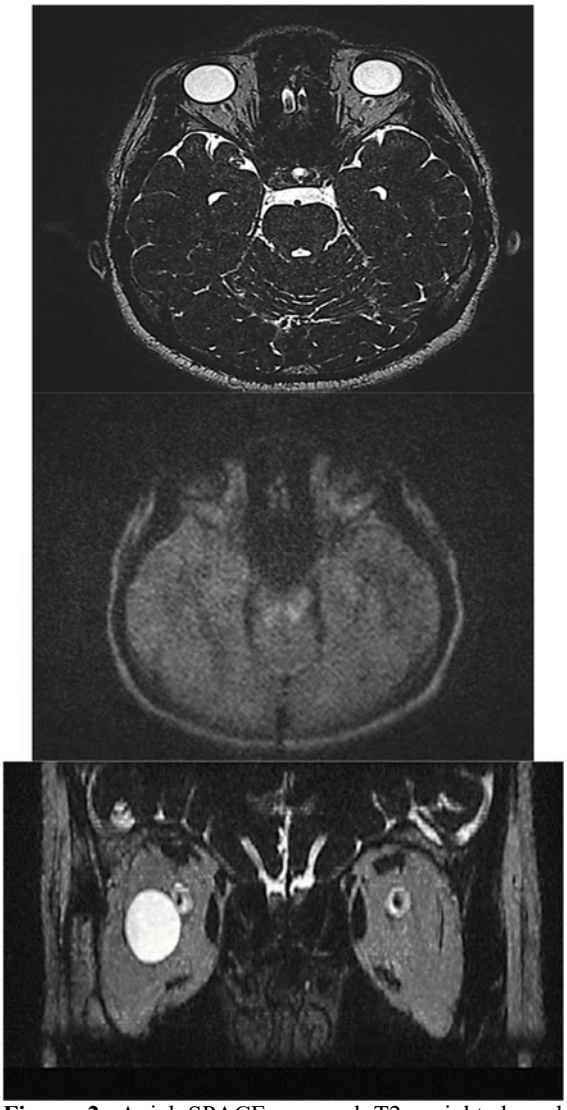

**Figure 2.** Axial SPACE, coronal T2 weighted, and axial non-echo planar imaging-diffusion weighted imaging (EPI-DWI) magnetic resonance images of a 31-year-old man with acute-onset anosmia due to COVID-19 infection shows normal appearing olfactory bulbs (red arrows) with no diffusion restriction

Imaging evaluation of anosmia is based on MRI, that can show olfactory bulbs and tracts properly.[5] Eliezer et al reported bilateral inflammation of olfactory clefts in a SARS-CoV-2 case with unremarkable olfactory bulbs.[6] Karimi-Galougahi et al. showed hypoactive orbitofrontal cortex on 18F-FDG PET/CT scan,[7] and normal morphology of olfactory bulb on MRI, which is consistent with our finding.[8]

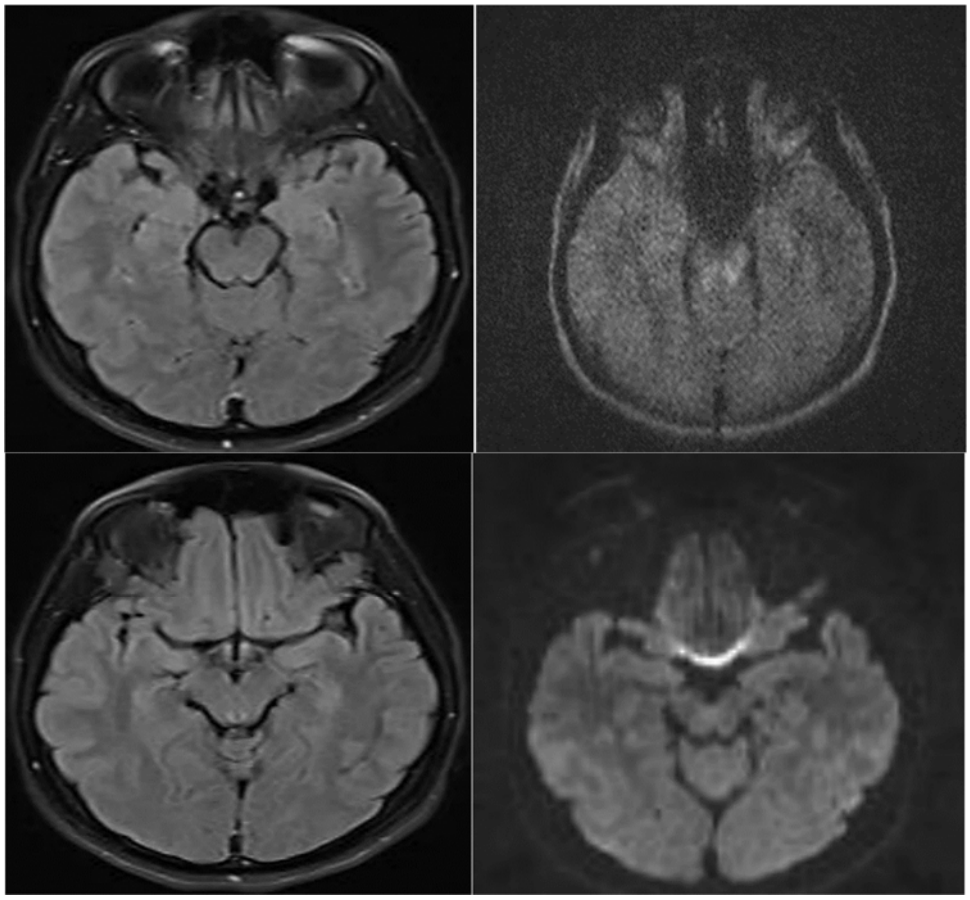

**Figure 3.** Axial FLAIR and diffusion weighted imaging (DWI) sequences from the level of olfactory tracts and rectus gyri

So far, no other study has shown abnormal olfactory bulb findings on MRI. This can be due to performing MRI on the acute phase of disease or inability of conventional MRI to show subtle changes of olfactory bulbs. However, we recommend further studies with hybrid imaging or follow-up assessment of olfactory bulbs in such patients.

**Conflict of Interests**

The authors declare no conflict of interest in this study.

**Acknowledgments**

None.

## References

1. Izquierdo-Dominguez A, Rojas-Lechuga MJ, Mullol J, Alobid I. Olfactory dysfunction in the COVID-19 outbreak. J Investig Allergol Clin Immunol 2020; 30(5): 317-26.
2. Seiden AM, Duncan HJ. The diagnosis of a conductive olfactory loss. Laryngoscope 2001; 111(1): 9-14.
3. Akerlund A, Bende M, Murphy C. Olfactory threshold and nasal mucosal changes in experimentally induced common cold. Acta Otolaryngol 1995; 115(1): 88-92.
4. Bagheri SH, Asghari A, Farhadi M, 1 Shamshiri A R, Kabir A, Kamrava S K, et al. Coincidence of COVID-19 epidemic and olfactory dysfunction outbreak in Iran. Med J Islam Repub Iran 2020; 34: 62.
5. Leboucq N, Menjot de Champfleur N, Menjot de Champfleur S, Bonafe A. The olfactory system. Diagn Interv Imaging 2013; 94(10): 985-91.
6. Eliezer M, Hautefort C. MRI evaluation of the olfactory clefts in patients with SARS-CoV-2 infection revealed an unexpected mechanism for olfactory function loss. Acad Radiol 2020; 27(8): 1191.
7. Karimi-Galougahi M, Yousefi-Koma A, Bakhshayeshkaram M, Raad N, Haseli S. (18) FDG PET/CT scan reveals hypoactive orbitofrontal cortex in anosmia of COVID-19. Acad Radiol 2020; 27(7): 1042-3.
8. Karimi-Galougahi M, Ghorbani J, Bakhshayeshkaram M, Naeini AS, Haseli S. Olfactory bulb magnetic resonance imaging in SARS-CoV-2-induced anosmia: The first report. Acad Radiol 2020; 27(6): 892-3.