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Can SARS-Cov-2 Invade the Brain Through An Ocular Route?

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Keywords

SARS-CoV-2; Coronavirus; Retina; Ocular; Synapse route

Opinion

Marinho et al., published the first-ever report using optical coherence tomography to evaluate the retina in Covid-19 patients [1].

In Hubei province a total of 12 of 38 patients had ocular manifestations. SARS-CoV have been found in tears of patients even without conjunctivitis [2].

Coronavirus (CoVs) infection requires Angiotensin Converting Enzyme-2 (ACE2) receptor, followed by its priming by host cell transmembrane protease, serine 2 (TMPRSS2) [3,4].

Both ACE2 and TMPRSS2 are ubiquitously present not only on the conjunctiva and cornea, but also inside the eye trabecular meshwork, aqueous humor, iris, ciliary body, non-pigmented ciliary epithelium, and retina [4].

Hence, a question arises: Can be considered an ocular route for SARS-CoV-2 to invade the brain?

The presence of the ACE2 receptors and TMPRSS2 protein on the corneal limbal stem cells may theoretically allow the SARS-CoV-2 to cross the ocular surface, and then entering the nervous system *via* the ophthalmic branch of trigeminal nerve. Moreover, the use of viruses driving expression of fluorescent proteins has been used for tracing neural connections, spreading from postsynaptic to presynaptic neurons [4,5].

CoVs can invade the brainstem via a synapse-connected route to the medullary respiratory center, possibly explaining the refractory respiratory distress commonly found in Covid-19 [3].

As the eye surface is mainly exposed for virus contamination [2], theoretically SARS-CoV-2 may invade the brain using synapse-connected routes from the cornea, retina, optic nerve [5]. Moreover, as the optic nerve subarachnoid space is filled by Cerebral Spinal Fluid (CSF) [4], this might be other route for the virus to reach the CSF, widely spreading its infection.

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