

Absence of severe acute respiratory syndrome coronavirus 2 in ocular postmortem studies



The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes the coronavirus disease 2019 (COVID-19), has infected over 15 million people and caused over 600 000 deaths globally, as of July 26, 2020.¹ Interestingly, the pooled prevalence of ocular manifestations among COVID-19 patients is thought to be as low as 5.5%,² with conjunctivitis accounting for the majority. Alongside this there has been considerable interest as to whether ophthalmic surgery can generate aerosols and ultimately whether such surgery can result in possible transmission.³

Little, however, is known regarding the presence of SARS-CoV-2 in intraocular tissues, with only one postmortem study to date, to the authors' knowledge.⁴ In this study, Bayyoud et al. demonstrate the absence of SARS-CoV-2 in multiple ocular sites (including conjunctiva, cornea, aqueous, vitreous sclera, and optic nerve) of one patient.

Further to this, we too describe the absence of SARS-CoV-2 in ocular postmortem studies of 3 patients with known SARS-CoV-2 (Table 1). Notably, none of the patients displayed signs of conjunctivitis. Furthermore, none of the patients received remdesivir, a nucleotide analogue prodrug that inhibits viral RNA polymerases, which has been used by some for those with SARS-CoV-2. Ocular postmortem samples were taken in conjunction with samples from other nonocular sites with no chemical sprays used. Conjunctival swabs were taken without excessive force being applied. Aqueous and vitreous biopsies of as greater volume as possible were taken. Samples were taken from both eyes. Aqueous samples from each eye were combined for analysis with the same procedure for vitreous samples. Given the relatively smaller volume of the anterior chamber and vitreous cavity, these ocular samples were less than that of other nonocular samples. In our study we used 2 different PCR assays. The AusDiagnostics PCR assay was used locally, at St Thomas' Hospital, London, to test for multiple respiratory pathogens and has been identified to have a sensitivity of 98.4% for

SARS-CoV-2.⁵ In comparison, samples sent to the Respiratory Virus Unit Laboratory, Public Health England, London, United Kingdom, were analysed using a real-time reverse transcription PCR assay using primers and probe sequences made public by Center for Disease Control and Prevention China.⁶ This targeted a conserved region of the open reading frame (*ORF1ab*) gene of SARS-CoV-2, alongside an internal control to monitor the extraction and reverse transcription PCR processes, with a specificity thought to be greater than 95% (personal communication).

We note the limitation of the small number of patients in our study and its postmortem nature. However, this also highlights the benefit of future studies investigating the presence of SARS-CoV-2 from ocular samples of live subjects. Additionally, as future therapies become available for the treatment of SARS-CoV-2, it will be useful to know more about associated ocular penetration, of which there is little in the literature to date.

Interestingly, our study demonstrates the presence of SARS-CoV-2 in similar nonocular sites to other studies performed in a similar time frame, highlighting that SARS-CoV-2 can be detected up to at least 9 days.⁷

Interestingly, much controversy exists regarding the ability of SARS-CoV-2 to infect ocular structures.⁸ It is understood that cellular infection with SARS-CoV-2 is reliant on SARS-CoV-2 S protein/angiotensin-converting-enzyme-2 receptor interaction, with limited evidence of such protein expression in the eye.⁹ Though, understandably, adequate personal protection is recommended for those in an ophthalmic outpatient and surgical setting.

Further to the above, we believe that our results support suggestions that the risk of transmitting SARS-CoV-2 via ocular tissues and fluid is minimal, especially in patients who have no attributable ocular symptoms.

Table 1 demonstrates the absence of SARS-CoV-2 in ocular tissue in comparison to the presence of SARS-CoV-2 in other nonocular samples. Age (years) and time from death to postmortem (days) are provided. Two different tests were used, those denoted with an asterisk (*) underwent assessment at Public Health England as described above, whereas all other samples were assessed using the AusDiagnostics PCR assay.⁵

Table 1—Absence of SARS-CoV-2 in ocular tissue

Patient ID	Age, y	Time to Postmortem (days)	Negative Ocular Samples	Positive Samples
1	72	9	Conjunctiva, vitreous*	Brainstem, cerebrospinal fluid*, kidney, liver, lung, myocardium, nose, throat
2	57	5	Conjunctiva	Faeces, lung, nasal
3	56	3	Conjunctiva, aqueous*, vitreous*	Faeces, lung, nasal, throat

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Footnotes and Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this article.