

# Can COVID-19 affect the eyes?

Recent research confirms that conjunctivitis can be an ocular sign of COVID-19 and suggests that SARS-CoV-2 may be transmitted through infected tears and conjunctival secretions.

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**ABSTRACT:** The primary mode of human-to-human transmission of coronavirus disease 2019 (COVID-19) is through contact with droplets and fomites containing severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). A few studies have reported conjunctivitis as an ocular sign of COVID-19. Although no studies to date have confirmed ocular transmission of COVID-19, the SARS-CoV-2 nucleotide has been detected in conjunctival specimens using reverse transcription polymerase chain reaction. This finding suggests that COVID-19 may be transmitted through infected tears and conjunctival secretions. Additionally, the eyes may serve as a portal of entry for SARS-CoV-2 when droplets or fomites are transferred from the conjunctiva to the nasopharyngeal space through the lacrimal duct. Precautions are therefore recommended to limit the possibility of ocular transmission of COVID-19.

**T**he coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) started in the city of Wuhan, China, in December 2019.<sup>1</sup> The virus spread quickly and resulted in 5 404 512 confirmed cases and 343 514 deaths globally by 26 May 2020.<sup>2</sup> Based on previous experience with the SARS 2003 epidemic caused by SARS-CoV-1, the primary mode of human-to-human transmission of COVID-19 is known to be through droplets and fomites.<sup>1</sup> According to the Centers for Disease Control and Prevention (CDC), the

incubation period for COVID-19 is between 2 and 14 days.<sup>1</sup> The symptoms of COVID-19 listed by the BC Centre for Disease Control and the World Health Organization are fever, dry cough, sneezing, sore throat, difficulty breathing, and tiredness.<sup>3,4</sup> New reports suggest that ocular manifestations may also be a symptom.

## Current research findings

A retrospective case series in Hubei Province, China, found 12 of 38 patients with clinically confirmed COVID-19 (31.6%; 95% CI, 17.5-48.7) had symptoms consistent with conjunctivitis, including chemosis, hyperemia, epiphora, and increased secretion.<sup>5</sup> The 12 patients also had more severe systemic disease such as dyspnea, respiratory failure, shock, and multiple organ dysfunction/failure.<sup>5</sup> Additionally, the 12 patients had higher white blood cell and neutrophil counts and higher levels of lactate dehydrogenase, procalcitonin, and C-reactive protein than patients without ocular symptoms.<sup>5</sup> Taken together, these results suggest that ocular manifestations of COVID-19 mostly appear in patients who have severe pneumonia.<sup>5</sup> Of the 12 patients with ocular manifestations, 11 (91.7%; 95% CI, 61.5-99.8) tested positive for SARS-CoV-2 on reverse transcription polymerase chain reaction (RT-PCR) from nasopharyngeal swabs, and 2 (16.7%) tested positive for SARS-CoV-2 on

RT-PCR from both conjunctival and nasopharyngeal swabs.<sup>5</sup> As well, when the conjunctival specimens of patients with COVID-19 were analyzed, a low prevalence of SARS-CoV-2 nucleotide was found (5.2%; 95% CI, 0.6-17.8).<sup>5</sup> The authors concluded “that SARS-CoV-2 might be transmitted through the eye” based on the ability of the virus to invade the conjunctiva.<sup>5</sup>

In another large study, researchers analyzed the clinical characteristics of 1099 hospitalized patients with laboratory-confirmed COVID-19 in 30 provinces of China.<sup>6</sup> They reported that nine patients (0.8%) had “conjunctival congestion.”<sup>6</sup>

In yet another study, researchers analyzed the tear and conjunctival samples of 30 patients with confirmed COVID-19.<sup>7</sup> No viral RNA was detected in samples from 29 patients without conjunctivitis, but it was detected in the sample from one patient with conjunctivitis.<sup>7</sup> The authors concluded that tear and conjunctival secretions were not the transmission route for the COVID-19 patients without conjunctivitis.<sup>7</sup>

In a cross-sectional study of 72 laboratory-confirmed COVID-19 cases, only two patients (2.78%) had conjunctivitis, and viral RNA was found in the ocular discharge of only one patient analyzed with RT-PCR.<sup>8</sup> The patient was a 29-year-old nurse who worked in the emergency department of a hospital in Wuhan, China.<sup>8</sup> Ocular examination of the patient

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revealed watery discharge and conjunctival congestion in both eyes.<sup>8</sup> The possibility of conventional conjunctivitis in this patient was excluded based on the normal corneal epithelium, the quiescent anterior chamber, and the absence of tenderness or enlargement of the preauricular lymph nodes.<sup>8</sup> The patient said she used a medical N95 respirator all the time while working and occasionally worked with a dislocated eye mask touching her eyelids.<sup>8</sup> The findings in this case suggest that exposure of conjunctiva to droplets or fomites containing SARS-CoV-2 may result in ocular disease.<sup>8</sup> Support for this is found in the fact that SARS-CoV-2 enters the host cells through angiotensin-converting enzyme 2 (ACE2) receptors, which are known to be expressed in human cornea and conjunctival tissues.<sup>8</sup> The authors concluded that although conjunctivitis is uncommon in COVID-19 patients in general, occupational exposure of medical staff should be seriously considered due to the high viral load in the hospital environment.<sup>8</sup>

A 2013 review of respiratory viruses that use the eye as a portal of entry provides some support for the ocular transmission of COVID-19.<sup>9</sup> The authors consider how liquid in the eye can be absorbed by the conjunctiva, sclera, or cornea, but is mostly transferred to the nasopharyngeal space through the lacrimal duct.<sup>9</sup> This liquid can then be transferred to the lower respiratory tract or gastrointestinal mucosa.

Additional support for ocular transmission of COVID-19 is provided by more recent research that describes how SARS-CoV-2 uses ACE2 receptors for entry into cells.<sup>10</sup> While ACE2 protein is mostly expressed on lung alveolar epithelial cells and enterocytes of the small intestines, which explains the lower respiratory tract symptoms of COVID-19,<sup>11</sup> it is also expressed in cornea and conjunctiva.<sup>12</sup>

### Infection control measures

COVID-19-associated conjunctivitis is indistinguishable from conjunctivitis with other viral causes and can be among the first presenting symptoms before fever or cough.<sup>1,13</sup> The American Academy of Ophthalmology (AAO) therefore recommends confirming patients have no history of respiratory illness, fever, or contact

with COVID-19-positive cases in the past 2 to 14 days before each office visit and that all ophthalmologists use mouth and nose protection (i.e., wear an N95 mask or surgical mask) and eye protection (i.e., wear a shield or goggles) when providing care for potentially infected patients.<sup>13</sup>

For ophthalmologic examinations, rooms and instruments should be disinfected after each patient visit based on current CDC recommendations using disinfectants specific to COVID-19, including solutions with at least 70% alcohol and diluted household bleach (5 tablespoons of bleach per gallon of water).<sup>13</sup> Because ophthalmologists work in close proximity to patients during slit lamp examination, protective plastic shields should be installed on slit lamps to reduce the risk of transmission via droplets.<sup>1</sup> The AAO also recommends postponing all elective care and surgeries to reduce the risk of disease transmission.<sup>13</sup>

Finally, COVID-19 should be included in the differential diagnosis for patients presenting with ocular signs or conjunctivitis.<sup>14</sup> Patients should be instructed to avoid touching their eyes, mouth, and nose and to discontinue using contact lenses if conjunctivitis is diagnosed.<sup>14</sup> The AAO advises patients who wear contact lenses to consider switching to glasses during the pandemic to reduce the number of times they touch their eyes.<sup>15</sup>

### Summary

Overall, more research is needed to clarify how COVID-19 affects the eyes. No studies to date have confirmed the ocular transmission of SARS-CoV-2.<sup>14</sup> However, conjunctivitis has been seen in some COVID-19 patients. Although SARS-CoV-2 is spread primarily through inhalation of respiratory droplets, infection may result from exposure of the conjunctiva to droplets and fomites. The presence of viral RNA in specimens from conjunctival swabs suggests infected tears and conjunctival may transmit COVID-19, and all precautions should be followed to limit the possibility of ocular transmission. ■

### Competing interests

None declared.

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