

Ophthalmological perspectives of coronavirus disease 2019

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COVID-19 infection becomes a global pandemic since December 2019 with many consequences on different medical fields including ophthalmology. This article will describe the ocular manifestations of COVID-19, discuss different dilemmas in ophthalmology as contact lenses and corneal transplants, describe different infection control measures and finally assess the importance of a webinars for scientific meetings.

Keywords:

COVID-19, infection control measures, ophthalmic manifestations, ophthalmology

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Introduction

Since December 2019, coronavirus disease 2019 (COVID-19) has become a global pandemic caused by the highly transmissible severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is a novel enveloped, positive single-stranded RNA beta coronavirus that causes COVID-19, originally linked to an outbreak in Wuhan city of China's Hubei province [1].

It is a highly contagious disease; the respiratory complications are the hallmark of the disease. However, other manifestations can also occur in the form of neurological, dermatological, and ocular manifestations [1].

The ophthalmologist's link to the disease is very obvious to the extent that the physician who first reported the beginning of the disease was an ophthalmologist. He first witnessed the spread of SARS like respiratory disease in his hospital. He got infected by an asymptomatic patient with glaucoma, and then he died owing to the disease [2].

The COVID-19 era has a great effect on many aspects of our lives. Ophthalmology practice comes on the top of the list. This effect will be witnessed in many aspects, including, and not limited to, patient diagnosis and treatment, physician training, and medical education. This article points out most of these issues.

Ocular manifestations of coronavirus disease 2019

Ocular manifestations of COVID-19 are overall rare in the published literature. Only nine (0.8%) of 1099 patients from 552 hospitals across 30 provinces in China were reported to have 'conjunctival

congestion.' As conjunctivitis is a common eye condition, ophthalmologists may be the first medical professionals to evaluate a patient with COVID-19 [3].

It is still vague the method by which SARS-CoV-2 accumulates in ocular secretions. There are many theories including direct inoculation of the ocular tissues from respiratory droplets or aerosolized viral particles, migration from the nasopharynx via the nasolacrimal duct, or even hematogenous spread through the lacrimal gland [4].

Examination reveals mild follicular conjunctivitis, watery discharge, and mild eyelid edema, which is very similar to any viral conjunctivitis, making the differentiation very difficult, and this raises the importance of good history taking about recent fever, respiratory symptoms, exposure, and travel history. It is self-limiting and can be managed with symptomatic care.

The conjunctival swabs tested positive for SARS-CoV-2 RNA for at least 5 days, with the Ct values gradually increasing. However, the detection was much lower than in nasopharyngeal swabs [4].

COVID-19 may present in the form of several neurological manifestations, such as dizziness, headache, acute cerebrovascular disease, epilepsy, encephalitis, and ataxia. Peripheral nervous system manifestations are in the form of hypoguesia,

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hyposmia, neuralgia, Guillain-Barre syndrome, and skeletal muscle injury [5].

Acute unilateral isolated oculomotor nerve palsy was reported in a 62-year-old patient without any respiratory manifestations or any other neurological manifestations. Inflammatory markers were elevated, and his computed tomography chest showing bilateral ground-glass patches. On the second day in the hospital, his illness evolved progressively, with presentation of fever, dyspnea, and body temperature of 38.9°C, and oxygen saturation declined to 90% on ambient air [5,6].

Bell's palsy occurred in a 65-year-old woman. Brain MRI showed no abnormality. However, the chest computed tomography revealed right ground-glass opacity, and the nasopharyngeal swab result was positive for SARS COVID-19. The symptoms of left facial paralysis were relieved after antiviral treatment [7].

Ophthalmological dilemmas during the pandemic

Contact lens wear

Risk of transmission of COVID-19 is worrisome, so contact lens (CL) wearers have many questions about their CL. Many of them shift from CL to glasses because of fear of acquiring infection from their CL. However, there is no scientific evidence that wearing glasses instead of CL provides more protection against COVID-19 [8].

According to the American Optometric Association, there is no risk of transmission of COVID-19 through CLs. Risk may come from touching faces and eyes during CL insertion and removal. So, CL wearers should avoid touching their face, including their eyes, with unwashed hands during CL handling [8].

Proper hand washing is mandatory before every CL insertion and removal; it entails thorough washing of the hands with soap and water for at least 20 s, followed by hand drying. Hand sanitizer that contains 70% alcohol can be used if soap and water are not available.

Monthly and 2-week CLs should be disinfected regularly according to the instructions from the manufacturer. Daily disposable lenses should be disposed each evening.

CL wearer should stop his/her lens wear if he/she feels ill with cold or flu-like symptoms. Moreover, CL

wearer should contact his/her doctor or optometry if CL prescription is nearing expiration or has expired [8].

Coronavirus disease 2019 virus protein in tears and conjunctival secretion

A case series on 38 patients (COVID-19 positive) was conducted in Hubei Province, China, and showed symptoms of conjunctivitis in 12 patients during hospitalization, mainly in patients with severe systemic disease. Of these 12 patients, 11 had positive RT-PCR evidence of virus in the nasopharynx. Two of these 11 patients also had RT-PCR evidence in the conjunctiva. Conjunctival injection could be secondary to the ventilator used in these patients, whereas initial conjunctivitis was present in only one patient [9].

A series by Xia *et al.* [3] on 30 patients with confirmed COVID-19 showed positive RT-PCR evidence of virus in tear and conjunctival secretions in only one patient who also had active conjunctivitis. However, the other 29 patients were negative and remained negative after retesting after 2–3 days.

However, a study by Jun *et al.* [10] on 17 patients (COVID-19-positive) showed no viral presence by RT-PCR in 64 samples from tear film. Conjunctival injection was present in only one patient from them.

Another study on 114 patients hospitalized with COVID-19 in China did not detect SARS-CoV-2 in the conjunctiva [11].

Many types of coronaviruses can cause severe respiratory disease after entry through ocular mucosa and then spread through the nasolacrimal system. This possibility may explain COVID-19 infection in health care workers who although wear the standard personal protective equipment but without ocular protection measures [4].

Wei *et al.* [12] intentionally exposed three rhesus monkeys to SARS-CoV-2 via an isolated ocular-conjunctival route versus an isolated intratracheal route to study the infection patterns. Three monkeys showed COVID-19 respiratory disease. The two monkeys infected via the ocular-conjunctival route showed viral evidence in conjunctival swabs on postinfection day 1, which disappeared on postinfection day 3. On the contrary, the virus was not detected in the conjunctiva of the third monkey infected via the intratracheal route. Postmortem study of the three monkeys on postinfection day 7 showed

weakly detectable viral load in the lacrimal gland, optic nerve, and conjunctiva, and a strongly detectable viral load in upper respiratory and pulmonary tissues in the two monkeys infected via ocular-conjunctival route. Regarding the intratracheally exposed monkey, the virus was strongly expressed in the pulmonary and gastrointestinal systems, with no detectable viral load in the ocular tissue.

Donor choice for corneal transplantation in coronavirus disease 2019 era

Early in the COVID-19 pandemic, most eye banks stopped corneal transplantation surgeries to avoid the risk of transmission of COVID-19 to the host, as the virus was detected in tears and conjunctival secretions in some patients. This decision was accepted owing to the large number of infected cases, and the most deaths were due to COVID infection. In addition, there were poor diagnostic options to ensure the donor was free from COVID-19 at the start of the pandemic.

On the contrary, there are many eyes that need corneal transplantation surgeries without delay. Advances in the diagnostic techniques have occurred daily, and the detection of COVID-positive cases became easier than before. So, the Eye Bank Association of America and the Global Alliance of Eye Bank Associations excluded only donors who are positive for, or in recent close contact with, COVID-19 since March 2020 [13,14].

Then, a recent study concluded that human coronaviruses remain infectious on surfaces at room temperature up to 9 days, even less at a temperature of 30°C or more. Coronavirus infectivity reduced significantly after using surface disinfection with 0.1% sodium hypochlorite or 70% ethanol on surfaces for 1 min at least [15].

Double povidone-iodine disinfection (at least 60 s in each time) is used routinely for donor preparation (according to standard E1.100 of the manual standard of EBBA). The in vitro antiviral activity of povidone-iodine against coronaviruses was proven. So, corneal donor, being a surface is supposed to be significantly noninfective after proper disinfection with povidone-iodine [16].

The most recent update by Eye Bank Association of America released on May 2020 about the safety of corneal tissue stated that no cases of transmission of SARS-CoV, MERS-CoV, or any other coronavirus via transplantation of ocular tissue have been reported till now [16].

Donor eligibility criteria during the COVID-19 pandemic are complex. Table 1 [13] includes the current guidance for eye banks and Medical Directors. Medical Director Review for final decision about donor eligibility is required in certain cases [16].

Table 1 Criteria for donor eligibility (adapted from Eye Bank Association of America)

PCR test status ^a	COVID-19 signs ^b	COVID-19 symptoms ^c	Plausible alternative of signs or symptoms	Close contact ^d	Eligibility	
Positive (in last 28 days)	Yes or no	Yes or no	Yes or no	Yes or no	Not eligible	
Negative (postmortem or recent postmortem)	Yes	Yes or no	Yes	Yes or no	Medical director review	
			No	Yes or NO	Not eligible	
	No	Yes	Yes	Yes or no	Medical director review	
			No	Yes or no	Not eligible	
Not done	Yes	Yes or no	Yes or no	Yes	Medical director review	
			Yes	Yes	Not eligible	
	No	Yes	Yes or no	No	Yes or no	Not eligible
			Yes	Yes	Yes	Not eligible
			No	NA	Yes	Not eligible
			No	NA	No	Eligible

COVID-19, coronavirus disease 2019. ^aRT-PCR SARS-CoV-2 test was done before or less than 24 h after death. If done, but result is inconclusive, then donor should be deferred. ^bPresence of one of the following signs within the 28 days before death: ARDS, pneumonia, and 'ground glass opacities' in computed tomography chest (regardless of whether another organism is present). ^cPresence of these symptoms within the 28 days before death. One of the following: cough or shortness of breath/difficulty breathing or two of the following: fever, chills, repeated shaking with chills, muscle pain, headache, sore throat, and new loss of taste or smell. ^dClose contact occurs while not wearing standard personal protective equipment and either.

Within about 2 m of a COVID-19 case for a prolonged period of time (>20 min) or in direct contact with infectious secretions of a COVID-19 case (being coughed on for example).

Infection control measures

Ophthalmologists are at a great risk of being infected by the disease because of the close proximity between ophthalmologists and patients during slit lamp examination and other examination techniques, and also owing to the relative long time of ophthalmological examination with longer waiting time; moreover, COVID-19-infected patients may present with conjunctivitis only [4]. All these factors may pose an infectious risk to ophthalmologists. On the contrary, most ophthalmological patients are elderly with multiple comorbidities who are at greater risk of severe COVID-19 infection. All the aforementioned factors increase the risk of cross-infection between patients and health care workers in outpatient clinics in ophthalmology more than other specialties.

A three-level hierarchy of control measures can be adopted [17].

Administrative control

To decrease the number of follow-ups and replacing them by phone calls or tele medicine, a triage system can be set up to identify patients at risk and postpone their appointments for at least 14 days. Social distancing should be applied in the waiting areas. All elective clinical services should be suspended. Infection control training should be provided to all clinical staff (Fig. 1).

Environmental control

Installation of protective shields on slit lamps, frequent disinfection of equipment, eye protection to physicians, minimizing gathering of staff for academic meetings should be done.

Disinfection of all instruments is required. The CDC recommends the use of disinfectants specific to COVID-19, including diluted household bleach and alcohol 70%; hydrogen peroxide, alcohols, sodium hypochlorite, or benzalkonium chloride are used worldwide for disinfection, mainly in health care settings.

Human coronaviruses can remain infectious on inanimate surfaces at room temperature for up to 9 days. In an observational study, it was described that students touch their face with their own hands on average 23 times per hour [18,19].

Personal protective equipment

Ophthalmology practices in Hong Kong recommended use of personal protective equipment for all cases regardless of SARS status, as well as hand hygiene measures and use of gloves, N95 masks, goggles, and gowns based on their experience with SARS in 2006 [17].

For patients who tested positive, they should be operated upon under general anesthesia, and the operation should be performed in an isolation operating theater, and all staff should wear isolation gowns, N95 respirators, and protective eyewear. In addition, patients should be requested to refrain from speaking as much as possible during the slit lamp examination (Table 2).

Regarding Moorfield experience during the COVID-19 era, there was marked decrease in the patients who presented to the emergency department, but most of them had sight-threatening conditions, and the number of patients with trauma, particularly those related to domestic abuse, increased.

Ironically, the number of patients scheduled for surgeries either urgent retinal detachment or monthly scheduled intravitreal injection was markedly decreased.

These dropout raised concerns through official channels to address awareness of the importance of seeking medical advice in sight-threatening conditions.

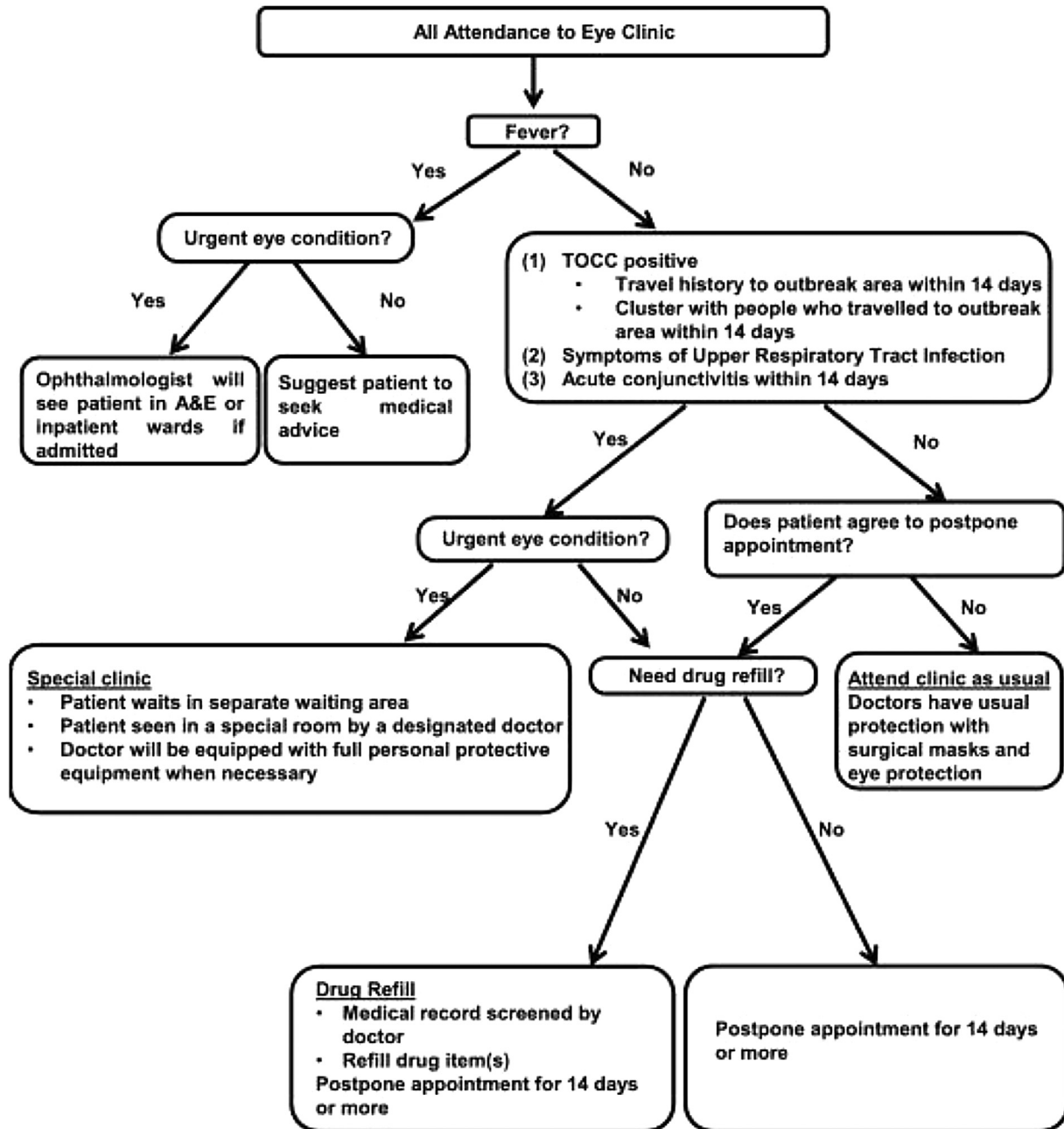
These factors will pose burden in the ophthalmological practice following the COVID-19 era, with increased number of patients with delayed emergency presentations [20].

Scientific meeting and webinars

With the emergence and dissemination of COVID-19, there was limitation of the education process at all levels to the extent that the United Nations Children's Fund (UNICEF) has estimated that there has been a disruption in the education of more than 1.57 billion students [21].

Many institutions have made efforts to minimize this disruption by using the available technology to allow academic activities without affecting neither the safety of the faculty members nor the quality of material given to the learners. There is a paradigm shift in terms of how we interact with each other with the concept of 'social distancing' recommendation by the WHO, including the classic scientific learning; ophthalmology is among the areas that witnessed this shift.

Figure 1



Triaging of the patients presented to OPC (adapted from Tracy *et al.* 2020) [27].

In 2004, Cook and Dupras [22] explained the most effective way to create an online learning platform to be used in medicine. Gewin [23] described helpful tips in the transition to online learning.

The plethora of the available scientific webinars organized in recent weeks has shown that the faculty members are willing to convey the knowledge; however, unification of this energy is needed, and we should have a road map toward training of the residents and fellows. This should be under the supervision of the major and well-established ophthalmological societies. These online meetings

may be the way we could teach the residents especially during and after the pandemic. With the redeployment of residents and fellows to serve in screening during the pandemic along with limited number of patients coming to the hospitals, there was marked decrease in the number of cases seen by the residents during the pandemic. In a survey done in India, 25% of residents were deployed to serve in COVID-19 screening, 54% were negatively affected regarding their surgical training, and 47% had negative effect on their classroom and theoretical lectures. However, 75% explained that the webinars were very helpful to them. This shows the importance of the

Table 2 Personal protective equipment in outpatient ophthalmic care (adapted from Kong, 2014)

PPE	Universal precaution measures	Special measures in case of suspected COVID-19 cases
Disposable cap	Standard	Standard
Installation of protective shields on slit lamps	Slit lamp breath shield [acrylic (thick shield)]	Slit lamp breath shield [acrylic (thick shield)]
Eye protection	Visor or goggles – advisable when in direct contact with patient Face shield – for high-risk procedures	Face shield – standard Goggles in addition to face shield – for high-risk procedure
Mask	Surgical mask – for routine setting N95 respirator – for high-risk procedure	N95 respirator
Gown	Water-repellent gown or water-resistant gowns	Water-repellent gowns
Gloves	Hand washing or use alcohol rub on hands in between cases Wear gloves in high-risk procedure	Wear gloves. Discard gloves, wash or alcohol rub the hands, and then put on new gloves in between cases

COVID-19, coronavirus disease 2019; PPE, personal protective equipment.

webinars, and it may be the way we can convey the transfer of knowledge in the near future, but it should be properly planned [24,25]. Simulation-based surgical training will have a major role in this time, with expected reduction of the number of patients presented to the hospitals [26].

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Conflicts of interest

There are no conflicts of interest.

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