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Eyes: conduit to COVID-19, relevance of eye protection, and face shield in ophthalmology waiting areas

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ABSTRACT

COVID-19 pandemic caused by highly contagious Severe Acute Respiratory Syndrome Coronavirus 2 has affected the health and economy of the population worldwide. A major route of transmission of coronavirus is through respiratory system by aerosols and microdroplets. Virus can also spread by direct or indirect touching of the inmate objects harboring live virus. Virus can gain access through the nasal and oral oropharyngeal mucosa. Coronavirus has been isolated from the ocular surface and tearfilm. Severe Acute Respiratory Syndrome Coronavirus 2 has been documented to drain from the ocular surface to oropharyngeal mucosa through tears. In the preventive measures, the mask acts as a barrier to touch and aerosol transmission and its use has been advocated all over the world. Transmissions through eyes (ocular surface and tear film) are possible, however, compared to the aerosol transmission the risk may be small. The use of glasses, safety goggles and face shields may provide protection to eyes from contamination and minimizes the risk of transmission from the ocular surface and tear film. In this review, the authors aim to highlight the role of the ocular surface and tear film in the transmission and possible measure to prevent the infection through the eyes.

Key words: Coronavirus disease; Acute respiratory coronavirus 2; COVID-19; Eye protection; Face shield; Tear film; Ocular surface

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INTRODUCTION

Coronavirus disease (COVID-19) produced by Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2) belongs to the coronavirus family having enveloped positive-stranded RNA viruses and infects vertebrates.[1] It is a rapidly spreading pandemic and has taken its toll on the global economy and health.[2] In the December 2019, 41 patients of "pneumonia of unknown etiology" were informed to the World Health Organization (WHO) from Wuhan City in Hubei Province in central China.[3] The virus was identified from a throat swab sample in January 2020 and named 2019-nCoV by the WHO,[4] then renamed as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).[1]

TRANSMISSION OF SARS-COV-2

SARS-CoV-2 much like other coronaviruses such as SARS-CoV and MERS-CoV has a zoonotic transmission.[5,6] As the phylogenetic research demonstrates similarity in SARS-CoV-2 and the Bat CoV RaTG13 genomic sequence, the Bat, has been alleged to be theusual host of the virus as well as the cause of spread to humans.[7] Human-human spread of the virus has been reported primarily through

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respiratory route by direct or indirect contact (droplets or aerosols from nasopharyngeal and oropharyngeal tracts of infected patients).[8] The risk goes up with the number of breaths of potentially infected air you take in while staying indoors. Indirect transmission (contaminated surfaces) is given special attention in locations like hospitals with a high risk of transmission.[9,10] Fecal-oral transmission is also a potential transmission route.[11]

Infectious droplets can contaminate conjunctival epithelium and the ocular surface.[12,13] The human angiotensin-converting enzyme-II (ACE2) and the novel CD147 receptors have been found to mediate viral invasion of human host cells.[14] ACE2 receptors have been reported to be present on the ocular surface (conjunctiva and cornea) and also in the aqueous humor.[14,15] The viral attachment and entry on host cells by the help of genes such as ACE2 and TMPRSS2 in the corneal and conjunctival epithelial cells are also seen in respiratory and intestinal epithelial cells.[16,17] This further suggests the importance of the ocular surface as an additional route for transmission and contracting the SARS-CoV-2 virus.[18]

OCULAR TROPISM AND EVIDENCE FROM LITERATURE

Ocular tropism is a likely feature of SARS-CoV-2 which is characteristically also noticed in other respiratory viruses.[19] Ocular surface and other mucous membrane exposure to body fluids and unprotected eyes have been previously related to an enhanced risk of virus spread from the infected cases to health-care personnel during the 2003 coronavirus epidemic in Toronto.[20] Recent studies have found tear samples and conjunctival swabs to be positive for SARS-CoV-2 in novel coronavirus pneumonia patients having conjunctivitis.[21,22]

Moreover, the ocular surface has been found to be a carrier of SARS-CoV-2, even in a patient without conjunctivitis.[23] Xie et al., tested ocular surface swabs and detected RNA strongly positive in a sample of two patients from 33 consecutive coronavirus cases (positive by quantitative real-time polymerase chain reaction (RT-PCR) (PCR) on nasopharyngeal swabs).[24] A study found SARS-CoV-2 RNA in 24% of the COVID-19 positive patients with moderate-to-severe infection.[25] Another study found one of 18 patients each (5.5% each) of two groups, that is, with and without conjunctivitis to have positive RT-PCR for SARS-CoV-2 RNA by conjunctival swab test.[26] Kumar et al., from Bangalore (Southern-India) found one out of 45 patients (2.23%) to be positive by real-time reverse transcription-PCR (RT-PCR) for the novel coronavirus in conjunctival swabs.[27] The nasolacrimal duct collects the tears from the conjunctival surface and transfers it to the lower nasal meatus, helping in the passage of the coronavirus to the respiratory tract mucosa. The ocular surface acts as a primary pathway for respiratory tract contamination, and a predominantly respiratory tract virus behaves like a true ocular pathogen.[28]

WAITING AREA IN OPHTHALMOLOGY CLINICS AND RISK OF VIRUS TRANSMISSION

There are two groups of patients in ophthalmology clinics/Outpatient departments. First, the conditions need urgent care with mostly younger actively working age group. The second group is the Senile/Pre-senile patients with/without associated systemic comorbidities. The first group may be more potential carriers of COVID-19 virus and the latter mostly includes susceptible patients who are more prone to contract and manifest severe form of COVID-19 infection. Most outpatient and emergency services have a large number of patients especially in waiting areas, and this may lead to COVID-19 outbreak as has already been reported.[29]

The majority of indoors and ophthalmic units/day care procedure rooms are closed indoors and poses very high risk of room contamination with infected aerosals. The more the time spent in such indoors such as waiting rooms more the risk of inhalation and the infection.

The implications of spread through ocular surface in patients with no ocular manifestations can be devastating in ophthalmic care as most ophthalmologists engage in investigations which involve direct touch with the ocular surface. These are contact applanation tonometry, gonioscopy, minor OT procedures like foreign body removal, chalazion incision, and curettage, etc. Even noncontact "air-puff" tonometry produces aerosols which can lead to virus spread.[30]

According to this AIOS-IJO consensus on preferred practice during COVID-19 pandemic, triage and screening for temperature are done at the entrance.[31] However, due to common non-febrile presentation, screening for temperature may not be "fool-proof" and COVID-19 carriers can be easily missed.[32] During the phase of high community transmission risk in pandemics like COVID-19, ophthalmology clinics also need to implement precise and accurate triage. Conjunctival secretions (9.0–10.5% prevalence), conjunctival congestion (4.0–5.5%), and conjunctivitis (0.8–4.8%) are COVID-19 associated ocular signs.[33] These can be easily identified and segregated at triage/waiting areas. Ocular secretions from infected patients can be a potential transmission route.[34] However, a large number of COVID-19 carriers are ocular symptom-free which poses a bigger risk.

Hand hygiene, safety eye shields, and mask/PPE etiquette have been well described for medical care providers.[31,35] However, face shields for patients in waiting areas of ophthalmology units have not been described well in protocols.

Measures like face shields have been discussed to be affordable and useful strategy to contain COVID-19 transmission in the community setting.[36] The Infectious Diseases Society of America included use of personal protective measures like masks and face shields for societal use.[37] Face shields can reduce immediate viral exposure by 96% within 18 inches from cough source according to a simulation study and after 30 min., blocked 68% of small aerosols.[38] Face shields use has advantages like re-usage, easy sterility/cleaning, and comfortable usage.

EYE-PROTECTION DEVICES (EPDS) FOR PATIENTS IN WAITING AREAS

In addition to frequent hand washing, social distancing and face masks, eye protection (EPD) offers added protection, the importance of which cannot be denied. Zeng et al., in their study found long-term eyeglasses usage (>8 h/day) may be protective against COVID-19 infection as long-term wearers were lesser in number in the COVID-19-positive hospitalized group versus the local population (5.8% v/s 31.5%).[39] The authors hypothesized that eyeglasses act as a barrier and prevent/discourage users from touching their eyes, in turn, protecting against transfer of virus or reducing the inoculums of virus.[40,41] The effectiveness of eye protection in the nosocomial spread of the respiratory syncytial virus has been shown in a systematic review of 40 studies.[42]

The official guidelines from U.K (February 2020) recommend the following eye/face protection measures: Surgical mask with the integrated face visor, full face shield, and polycarbonate protective glasses.[43] The authors had previously (2019) discussed various easily available options for eye-protection in small scale workshops in Bangalore (Southern India).[44] They discussed four options. All these are easily available and are being used by health-care providers in the hospitals already during the COVID-19 pandemic and shown in Figure 1 and 2. The EPD without side shields (option 1) is the cheapest in cost and most easily available. The glasses with side shields (option 2) offer more protection and used in most hospitals as post-operative glasses. Option 3 was wide view safety goggles and these are available in sports shops with the advantage of fitting over prescription glasses. The face shield/visor (Option 4) according to the authors offers the widest area of protection. The same can be followed by in otolaryngology and dental clinics where there is similar close contact with probable asymptomatic potential ocular surface SARS-CoV-2 carriers.[45,46]

The variations/mutations in COVID genomes are proved to cause more rapid spread and more lethal compared to original strains. The mutant virus found in united kingdom (lineage B.1.1.7), south Africa (B.1.351), California (B.1.142 and B.1.429) and double mutants in India (B.1.617) have

Figure 1: (a) EPD without side shields (Option 1), (b) Glasses with side shields (Option 2), (c) Wide view safety goggles (Option 3), and (d) The face shield/visor (Option 4)

Figure 2: (a and b) Use of preventive/protective eye devices in ophthalmology waiting area

proven very contagious. As the danger of a new waves of COVID-19 looms large after detection of SARS-CoV-2 variants,[47,48] the role of eye protection should be further studied as a preventive strategy.[49]

Transmission of COVID-19 through ocular surface should not be ignored, and the use of EPD by the patients is the need of the hour. We as ophthalmic/eye care providers should make all efforts to curtail any probable spread through the ocular surface route in the waiting area/halls, no matter how less statistical probability there may exist.

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