



*Original Contribution*

**COVID-19 – OCULAR INVOLVEMENT, FINDINGS AND THE RISK OF POTENTIAL TRANSMISSION**

**S. Stoykova<sup>1,2</sup>, M. Dragomirova<sup>3</sup>**

<sup>1</sup>Department of Surgery, Obstetrics and Gynecology, Faculty of Medicine, Sofia University St. Kliment Ohridski, Sofia, Bulgaria

<sup>2</sup>Ophthalmology Department, Lozenetz Hospital Sofia, Bulgaria,

<sup>3</sup>Department of "Optics and Spectroscopy, Faculty of Physics, Sofia University St. Kliment Ohridski, Sofia, Bulgaria

**ABSTRACT**

The coronavirus disease COVID-19 affects primarily the respiratory system in humans, but it also affects many other organs, including the eyes. The ocular surface is considered as a SarsCoV-2 gateway; it also plays an important role in its spread through the conjunctival secretions. Conjunctival secretion swabs of 50 people were examined by real-time PCR methodology. All of them were hospitalized due to medium and moderately severe COVID-19 in Lozenetz Hospital Sofia during the period of October-November 2021. The results showed that the severity of clinical findings in the anterior eye segment and subjective complaints did not correspond to the presence of Sars-Cov-2 in conjunctival samples. Nevertheless, eye care specialists need to take notice while working in their ophthalmic practices in order to reduce the risk of virus transmission and diminish SarsCoV-2 infection among visiting patients and health care professionals. An effective program and specific precautions need to be exploited in order to effectively prevent disease spread.

**Key words:** COVID-19, conjunctival samples, RT- PCR, SarsCoV-2, eye symptoms

**INTRODUCTION**

The coronavirus disease – COVID-19 is caused by a virus named Sars-Cov-2 as it can cause severe acute respiratory distress syndrome (SARS). Due to its evident contagiousness and mass spread, the World Health Organization declared a global pandemic in February 2020 when millions fell ill and died as a result of respiratory involvement and other multi-organ system disorders.

Involvement of the conjunctiva is one of the most recurrent and commonly reported ophthalmic manifestations of COVID-19, incl. congestion and hyperemia, chemosis, epiphora, which usually occur in more than 1/3 of patients. (1). In some more infrequent and rare cases, other sensitive to viral infection structures of the visual analyzer are also affected - retina, uvea, optic nerve. (2) (3). Ocular symptoms in COVID-19 have not yet been sufficiently studied and well systematized. Aggarwal K et al. (4) published in 2020 an analysis of several electronic databases and the most common eye complaints were pain 31% and discharge - 19% and as objective finding - hyperemia 10% and conjunctivitis - 8%.

**\*Correspondence to:** Slavena Stoykova,  
Ophthalmology Department, Lozenetz Hospital Sofia,  
Bulgaria, Koziak 1 Str, 1407 Sofia, Bulgaria;  
[stoykova\\_sl@abv.bg](mailto:stoykova_sl@abv.bg); +359 888 898 850

## PURPOSE

The aim of the present study is to investigate ophthalmological findings in patients with coronavirus disease treated in hospital and to evince the presence of Sars-Cov-2 in conjunctival specimens. We intend to investigate possible links between positive ocular PCR samples, patients' complaints and objective ophthalmological findings in order to develop safe work recommendations for eye care specialists.

## MATERIALS AND METHODS

Conjunctival swabs of 50 people with confirmed SarsCov2 in the nasopharynx were examined in Lozenetz Hospital by RT-PCR. They were hospitalized due to medium and moderately severe Covid-19 during the period of October-November 2021. At the same time as the nasal one, a sample from the lower conjunctival fornix was also obtained by the same doctor. The eye sample was taken with a short-bristled brush and not with Schirmer test strip filter paper because of greater reliability scientific recommendations (5). Both were examined simultaneously in the

Microbiology and Virology Laboratory in Lozenetz Hospital by qualified specialists according to the standard protocols and following the virus distinctions (6).

Mathematical and statistical methods were also used to process the obtained data. This permits liable evaluation and comparison of the results with other scientific data sources and enables the development of further guidelines for low-risk behavior to ophthalmology field working personnel.

## RESULTS AND DISCUSSION

Our work at Lozenetz Hospital established that conjunctival PCR samples for Sars-Cov-2 were positive in six out of fifty tested, which amounts to 12%. This correlates with results from the literature, where positive samples report mainly between 7.5% and 24% (5)(7)(8), according to other analyses even 3.5% (4). 98% of our patients, e.g., almost all of them have ophthalmological findings and complaints, which means that they most likely required a specialist consultation.

*Table 1. Eye samples of patients tested by RT-PCR*

### Conjunctival PCR Tests

	Number of Patients	Percent ratio
<b>Negative Conjunctival PCR Swap</b>	44	88 %
<b>Positive Conjunctival PCR Swap</b>	6	12 %
<b>Total</b>	50	100 %

It is not known how many asymptomatic carriers of Sars-Cov-2 subsequently develop the disease (9, 10), and not all patients with symptoms of conjunctivitis who come for ophthalmic consultation are necessarily Sars-Cov-2 infectious carriers. Due to SarsCov2 being a respiratory virus, protective measures are frequently neglected in patients with no such complaints. This is especially true for eye clinics routines where the work of specialists is usually in close contact with the face of patients (11). A possible ocular route of infection with Sars-Cov-2 was reported in January 2020. (12) It is believed that the doctor who firstly raised an alarm for the highly contagious nature of Sars-Cov-2 was, actually, an ophthalmologist at the hospital in Wuhan, China. Dr. Li Wenliang likely became ill himself while following up with asymptomatic

ophthalmic patients and subsequently died of coronavirus pneumonia. (13).

The ocular tropism of Sars-Cov-2 and its local manifestations warrant gained attention and further investigation. (9, 10). As of today, the exact ophthalmic mechanism of infection is yet to be clarified. It is likely that the virus binds to the receptors located on the ocular surface and the lipophilic tear film. (15)

Ya-Ping et al., summarize and process ophthalmological publications related to COVID-19 and give recommendations on the occupational risk of eye specialists due to possible ocular transmission of the virus even in patients without specific local symptoms (16). Although the presence of Sars-Cov-2 on the ocular surface is relatively low, the medical staff should strictly

follow a set of strict safety measures and personal protective equipment, including helmets, shields and goggles. (17)

**Table 2. Ophthalmological Findings Frequency according to PCR Eye Tests**

		PCR Eye Tests		Total
		Negative	Positive	
Hyperemia	Number of Patients	43	6	
	Number of Patients			
	%	98%	100%	
	Percentage of All	86%	12%	98%
Discharge	Number of Patients	29	3	
	Number of Patients			
	%	58%	50%	
	Percentage of All	38%	2%	40%
Chemosis	Number of Patients	28	1	
	Number of Patients			
	%	64%	2%	
	Percentage of All	56%	2%	58%
Subjective Complains	Number of Patients	43	6	
	Number of Patients			
	%	98%	100%	
	Percentage of All	86%	12%	98%
		44	6	50
		88,0%	12,0%	100,0%

Practically all people tested at Lozenetz Hospital - both with Sars-Cov-2 positive and negative conjunctival samples also have subjective eye complaints. They are identified to varying degrees in 98% of patients. The same applies to hyperemia of the conjunctiva, which is found in patients with a minor percentage difference. Chemosis is present in 2% of the positive and 64% of the

negative patients, while conjunctival discharge is approximately equal - respectively in 50% of the positive and 58% of the negative examined.

According to a meta-analysis published in 2021 by Naiiri et al, (18) the symptoms frequency is about 11%. Other registered complaints are foreign body sensation in 16%, itching and

tearing - 13%, pain 10%, discharge - 9%, and as an objective finding - hyperemia and conjunctivitis - 89%.

Our study at Lozenetz Hospital shows similar results. 12% of the positive patients have subjective eye symptoms, and they are mostly mild - in 10%. Negative patients have eye complaints in 88% of cases, and they are also mainly classified as mild - in 36%.

STOYKOVA S., et al.

Objective findings in the examined patients are marked as absent, and if there is one – based on its severity, it is divided into 4 groups - mild, medium, moderate and severe. Patients with a positive eye PCR, who have mild ophthalmological symptoms make up 10% of all examined, those with moderate symptoms – about 2%. In these groups, negative patients were 36% and 26%, respectively.

**Table 3. Ophthalmic Manifestation Extent Distribution according to PCR Eye Tests**

		PCR Eye Tests		Total
		Negative	Positive	
No Findings	Number of Patients	1	0	
	Number of Patients			
	%	2%	0%	
	Number of Patients			
	Percentage of	2%	12%	2%
Mild	Number of Patients	18	5	
	Number of Patients			
	%	40%	83%	
	Number of Patients			
	Percentage of	36%	10%	46%
Moderate	Number of Patients	11	0	
	Number of Patients			
	%	25%	0%	
	Number of Patients		0	
	Percentage of	22%	0%	22%
Intermediate	Number of Patients	13	1	
	Number of Patients			
	%	30%	17%	
	Number of Patients			
	Percentage of	26%	2%	28%
Severe	Number of Patients	1	0	
	Number of Patients			
	%	2%	0%	
	Number of Patients			
	Percentage of	2%	0%	2%
Total	Number of Patients	44	6	50
	Percentage of	88%	12%	100%

We examined eye samples from COVID 19 patients by rt PCR method for the viral presence in conjunctival fluid in Lozenetz Hospital, Sofia. Data was being collected and analyzed regarding the objective finding in the anterior eye segment and subjective complaints of patients. In 12% of the proven carriers, the virus was also found in conjunctival samples. The comparison with the exported data from the international sources showed a correlation in most of the represented indicators – the positive percentage of conjunctival samples, frequency of ophthalmological findings and subjective complaints.

Lacrimal secretion and ocular surface may be an underestimated source of Sars-Cov-2. Conjunctival involvement may be the only or early symptom of COVID-19. Increased attention to specific occupational risks in ophthalmic practice is essential. Its management can be carried out by applying safer and non-invasive methods of examination such as disposable consumables, prescription of correction using a phoropter, etc. Medical staff safety requires indispensably personal protective equipment, meticulous disinfection with appropriate preparations of utensils, devices and surfaces, ventilation and preliminary triage of patients.

## CONCLUSIONS

1. Examination of conjunctival samples by means of real-time PCR is a science-based method for isolating Sars-Cov-2 from the ocular surface and shows virus shedding in the tear film of COVID-19 patients.
2. Not all patients with COVID-19 and proven virus-carriers in the nasopharynx have a positive PCR conjunctival sample, only in 12% of those examined.
3. Sars-Cov-2 detection in conjunctival samples by real-time PCR has a much lower reliability as a primary proof method compared to the nasopharyngeal test approach.
4. Tears and ocular surface contact should be further investigated and considered as a potential COVID-19 spread route not only in proven cases, but also in patients with minor ocular symptoms.
5. The clinical finding severity in the anterior eye segment and subjective complaints do not

correspond to the presence of Sars-Cov-2 in conjunctival samples tested by real time PCR.

6. It is important to develop a risk prevention program to diminish infection and lower spread COVID-19 among eye care specialists.

## REFERENCES

1. Wu P, Duan F, Luo C, Liu Q, Qu X, Liang L, Wu K. Characteristics of Ocular Findings of Patients with Coronavirus Disease 2019 (COVID-19) in Hubei Province, China. *JAMA Ophthalmol.* 2020 May 1; 138(5):575-578. doi: 10.1001/jamaophthalmol.2020.1291. PMID: 32232433; PMCID: PMC7110919.
2. Marinho PM, Marcos AAA, Romano AC, Nascimento H, Belfort R Jr. Retinal findings in patients with COVID-19. *Lancet.* 2020 May 23; 395(10237):1610. doi: 10.1016/S0140-6736(20)31014-X. Epub 2020 May 12. PMID: 32405105; PMCID: PMC7217650.
3. Oskar A., Zdravkov Y., Hristova R. et al., Ocular manifestations in COVID-19: clinical case reports and a literature review, *BULGARIAN REVIEW OF OPHTHALMOLOGY*, 2021, Vol.65, No 2 DOI: <http://dx.doi.org/10.14748/bro.v65i2.7822>
4. Aggarwal K, Agarwal A, Jaiswal N, Dahiya N, Ahuja A, Mahajan S, Tong L, Duggal M, Singh M, Agrawal R, Gupta V. Ocular surface manifestations of coronavirus disease 2019 (COVID-19): A systematic review and meta-analysis. *PLoS One.* 2020 Nov 5;15(11):e0241661. doi: 10.1371/journal.pone.0241661. PMID: 33151999; PMCID: PMC7643964.
5. Arora R, Goel R, Kumar S, Chhabra M, Saxena S, Manchanda V, Pumma P. Evaluation of SARS-CoV-2 in Tears of Patients with Moderate to Severe COVID-19. *Ophthalmology.* 2021 Apr; 128(4):494-503. doi: 10.1016/j.ophtha.2020.08.029. Epub 2020 Aug 31. PMID: 32882309; PMCID: PMC7458068.
6. Chen Y, Liu Q, Guo D. Emerging coronaviruses: Genome structure, replication, and pathogenesis. *J Med Virol.* 2020 Apr; 92(4):418-423. doi: 10.1002/jmv.25681. Epub

- 2020 Feb 7. *Erratum in: J Med Virol.* 2020 Oct;92(10):2249. PMID: 31967327; PMCID: PMC7167049.
7. Atum M, Boz AAE, Çakır B, Karabay O, Köroğlu M, Öğütlü A, Alagöz G. Evaluation of Conjunctival Swab PCR Results in Patients with SARS-CoV-2 Infection. *Ocul Immunol Inflamm.* 2020 Jul 3; 28(5):745-748. doi: 10.1080/09273948.2020.1775261. Epub 2020 Jun 22. PMID: 32569495.
  8. Vesely, P., Novakova, E., Stubna, M. et al. Coronavirus disease (COVID-19) and conjunctival sac swab findings. *J Ophthalmol Inflamm Infect* 12, 8 (2022). <https://doi.org/10.1186/s12348-022-00285-3>
  9. Xia J, Tong J, Liu M, Shen Y, Guo D. Evaluation of coronavirus in tears and conjunctival secretions of patients with SARS-CoV-2 infection. *J Med Virol.* 2020 Jun;92(6):589-594. doi: 10.1002/jmv.25725. Epub 2020 Mar 12. PMID: 32100876; PMCID: PMC7228294.
  10. Li JO, Lam DSC, Chen Y, et al. Novel Coronavirus disease 2019 (COVID-19): The importance of recognising possible early ocular manifestation and using protective eyewear *British Journal of Ophthalmology* 2020;104:297-298.
  11. Bacherini D, Biagini I, Lenzetti C, Virgili G, Rizzo S, Giansanti F. The COVID-19 Pandemic from an Ophthalmologist's Perspective. *Trends Mol Med.* 2020 Jun;26(6):529-531. doi: 10.1016/j.molmed.2020.03.008. Epub 2020 Apr 6. PMID: 32470381; PMCID: PMC7195312.
  12. Dai X. Peking University Hospital Wang Guangfa Disclosed Treatment Status on Weibo and Suspected Infection Without Wearing Goggles. *Xinjing Newspaper.* (2020). Available online at: <http://www.bjnews.com.cn/news/2020/01/23/678189>. (Accessed January 24, 2020)
  13. Green A, Li Wenliang. *Lancet.* 2020 29 February-6 March;395(10225):682. doi: 10.1016/S0140-6736(20)30382-2. Epub 2020 Feb 19. PMCID: PMC7137172.
  14. Ho D, Low R, Tong L, Gupta V, Veeraraghavan A, Agrawal R. COVID-19 and the Ocular Surface: A Review of Transmission and Manifestations. *Ocul Immunol Inflamm.* 2020 Jul 3;28(5):726-734. doi: 10.1080/09273948.2020.1772313. Epub 2020 Jun 16. PMID: 32543262.
  15. Coroneo MT. The eye as the discrete but defensible portal of coronavirus infection. *Ocul Surf.* 2021 Jan; 19:176-182. doi: 10.1016/j.jtos.2020.05.011. Epub 2020 May 21. PMID: 32446866; PMCID: PMC7241406.
  16. Jin YP, Trope GE, El-Defrawy S, Liu EY, Buys YM. Ophthalmology-focused publications and findings on COVID-19: A systematic review. *Eur J Ophthalmol.* 2021 Jul;31(4):1677-1687. doi: 10.1177/1120672121992949. Epub 2021 Feb 8. PMID: 33557602; PMCID: PMC8369910.
  17. Zhang X, Chen X, Chen L, Deng C, Zou X, Liu W, Yu H, Chen B, Sun X. The evidence of SARS-CoV-2 infection on ocular surface. *Ocul Surf.* 2020 Jul;18(3):360-362. doi: 10.1016/j.jtos.2020.03.010. Epub 2020 Apr 11. PMID: 32289466; PMCID: PMC7194535.
  18. Nasiri N, Sharifi H, Bazrafshan A, Noori A, Karamouzian M, Sharifi A. Ocular Manifestations of COVID-19: A Systematic Review and Meta-analysis. *J Ophthalmic Vis Res.* 2021 Jan 20;16(1):103-112. doi: 10.18502/jovr.v16i1.8256. PMID: 33520133; PMCID: PMC7841281.