

DEVELOPMENT OF THE DRY EYE DISEASE AFTER COVID-19

Poltava State Medical University (Poltava, Ukraine)

i.olefir@pdmu.edu.ua

In 2019, the COVID-19 epidemic shocked the whole world and fundamentally changed the way of life mostly of all people, which reduced social contacts and began to spend more time in front of gadget screens due to quarantine. Recent epidemiological studies have shown a significant increase in the number of patients that suffering from eye strain due to the active use of gadgets and changes in lifestyle, work and even household.

Aim of the study - to evaluate and compare the occurrence of dry eye disease (DED) and its severity in patients with a history of SARS-CoV-2 and in patients without symptoms of coronavirus infection for more than 1 year.

We monitored 46 patients, who were divided into two groups depending on the duration of the SARS-CoV-2 infection.

Patients with an early period after COVID-19 had in 78% of cases (18 out of 23 patients) manifestations of DED, that included - lacrimation, moderate photophobia, foreign body sensation and decreased visual acuity. The above-mentioned complaints in the vast majority (52% of cases) occurred in women (12/23). In another cohort of patients who had signs of coronavirus infection more than 1 year ago, manifestations of dry eye disease were detected only in 35% of cases (8 patients out of 23 examined in this group).

After our comparison the study groups according to the data of a specific examination for the presence and severity of dry eye and patients complaints, it was found that people who suffered from SARS-CoV 3-4 months before the study were more than 2 times more likely to suffer from dry eye manifestations, in comparison to individuals with coronavirus infection for more than 1 year.

Key words: dry eye disease, tear film, interferometry, Covid-19, computer devices.

Connection of the publication with planned research works.

The work is included in the SRW of the Department of Otorhinolaryngology with Ophthalmology "Optimization of the study of morphometric and functional parameters of the retina and optic nerve in the treatment of glaucoma", state registration № 0124U001921.

Introduction.

The beginning of the XXI century for scientists and doctors became a time for rethinking the role of coronaviruses in the development of human diseases and change approaches to understanding their epidemic potential [1, 2]. Initially, the severe acute respiratory syndrome (SARS) caused by SARS-CoV showed that coronaviruses can cause not only mild and moderate acute respiratory diseases, but also severe, and even fatal, primary viral pneumonias, mortality from which, according to the WHO, was 9.6% worldwide, while cases were registered in 29 countries all over the world [3, 4].

2019-2020 years will go down in history as the beginning of the COVID-19 pandemic, which was declared by the WHO on March 11, 2020. The situation is changing rapidly. So far, our knowledge about the causative agent has deepened significantly, we have managed to learn about its origin, mechanisms and ways of spreading, pathogenesis of the disease and clinical manifestations, intensive searches are underway for effective etiotropic and pathogenetic drugs for the treatment of this disease, the first vaccines have been created, which still are undergoing trials [5]. Study of the pandemic potential of coronaviruses and improvement of appropriate biosecurity measures around the world continues.

Among the ophthalmological symptoms, the development of viral conjunctivitis, episcleritis, microhemorrhages on the retina, the occurrence of maculopathies and optic neuritis were most often reported. These symptoms most often occurred during the coronavirus

disease [6]. However, the recovery period after a severe viral infection, according to the latest data, also has its own variants of pathological ophthalmic conditions. One of them is dry eye disease, which causes significant discomfort and even a decrease in work capacity and quality of life, because, unfortunately, it is impossible without constant, supportive therapeutic treatment [1-4]. In 2019, the COVID-19 epidemic shocked the whole world and fundamentally changed the way of life mostly all people, who reduced social contacts and spent more time in front of gadget screens due to quarantine [6-9]. Recent epidemiological studies have shown a significant increase in the number of patients that suffering from eye strain due to the active use of gadgets and changes in lifestyle, work and even household [4-6].

The fact that the prevalence of dry eye disease is associated with the use of displays is absolutely proved [7-9]. This condition is characterized by the loss of homeostasis of the tear film, which is accompanied by the following eye complaints, which include: dryness, discomfort, pain, feeling of «sand» in the eyes, decreased visual acuity, foreign body sensation [10]. Dry eye disease not only affects the current state of the quality of life of the population, but also reduces not only the work capacity and efficiency of the work process [11-13], but also increases the economic imbalance in society [14-16].

The aim of the study.

To evaluate and compare the occurrence of dry eye syndrome and its severity in patients with a history of SARS-CoV-2 and in patients who had no symptoms of coronavirus infection for more than 1 year.

Object and research methods.

We monitored 46 patients who were divided into two groups depending on the duration of SARS-CoV-2 transmission. The average age of the examinees was 42.4 years. Women made up 52% (24 patients out of 46

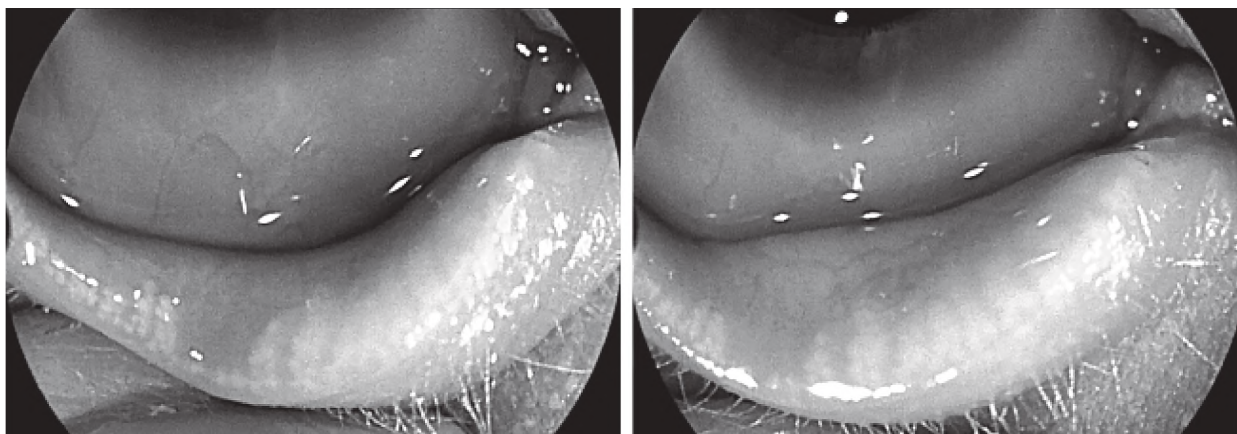


Figure 1 – The condition of the meibomian glands of a patient in the first group.

people) of the total number of subjects, men – 48% (22 out of 46 people), respectively.

The study was conducted in accordance with the principles of the Helsinki Declaration on the Protection of Human Rights, the Council of Europe Convention on Human Rights and Biomedicine, and the provisions of the relevant laws of Ukraine. Written informed consent was obtained from all patients who participated in the study.

The first group included 23 patients who suffered from Covid-19 3-4 months before conducting our study. The second group consisted of 23 patients, whom coronavirus disease were laboratory and clinical indicated about a year ago.

The exclusion criteria were: the presence of clinically established dry eye syndrome before the COVID-19, elderly patients, patients with existing endocrinological diseases, persons who have undergone ophthalmic operations and have other ophthalmic pathology, IT workers and other specialties that require long-term use of digital displays. All patients underwent general ophthalmological examinations, as well as specific tests for detecting dry eye disease – OSDI test, interferometry, TBUT test and Schirmer's test.

Statistical calculations of the results were performed using the Statistica 10.0 software package (Statsoft, USA). Average values (M) and standard deviation (SD) of all parameters detected in the subjects were compared using a paired t-test.

Research results and their discussion.

The first group of patients, whom we can call early convalescents, the results of general ophthalmological examinations were as follows: the average value of visual acuity was equal to 0.87 ± 0.03 , the IOP value was within the normal range and amounted to an average of 18.3 ± 4.2 mm. As for the complaints of the examinees of this group, we found that in 78% of cases (18 out of 23 patients), lacrimation, moderate photophobia, foreign body sensation and decreased visual acuity were observed. It was detected that the above-mentioned complaints in the vast majority (52% of cases) occurred in women (12 out of 23 subjects).

During specific examinations for dry eye syndrome detection, we obtained the following results, according to the OSDI test, a normal state of the ocular surface was found in 22% of patients (5/23), mild manifestations of dry eye – 35% of cases (8/23), medium severity – 39% of the examined (9/23) and 1 patient had a severe

stage of dry eye disease (4%). The obtained images and interpretation of interferometry corresponded to the results of the OSDI test.

The data of the Schirmer and TBUT tests are shown in table 1.

Table 1 – Average values of Schirmer and TBUT tests in patients of the first group according to gender division

Gender	Schirmer's test (M $\pm$ m)	TBUT test (M $\pm$ m)
Men	8,07 $\pm$ 1,02 mm	9,1 $\pm$ 0,8 s
Women	6,24 $\pm$ 0,5 mm	5,4 $\pm$ 1,2 s

The above values indicate that the severity of dry eye manifestations is more typical for women. The average values of this numbers indicate the predominance of the average degree of severity of the manifestation of DED.

Figure 1 shows the condition of the meibomian glands of a patient in the first group. According to which it is possible to clearly define the pronounced dysfunction of the glands.

A completely different clinical picture was observed in the subjects of the 2 groups who contacted the coronavirus infection more than 1 year ago. No significant changes were found in general ophthalmological examinations. Visual acuity was 0.92 ± 0.08 . The average values of intraocular pressure were also within the normal range and amounted to 20.1 ± 2.14 mmHg. Complaints, that characterize dry eye (watering, photophobia, redness of the eyes, feeling of a foreign body or «sand in the eyes») were found in only 35% (8 patients out of 23 examined in this group). therefore, these manifestations were observed often in women – 75% of cases (6 patients out of 8).

Regarding to the specific examination for the severity of dry eye manifestations, we obtained the following results, which are shown in table 2.

Table 2 – Average values of Schirmer, TBUT and OSDI tests in patients of the second group according to gender division

Gender	Schirmer's test (M $\pm$ m)	TBUT test (M $\pm$ m)	OSDI test (M $\pm$ m)
Men	14,3 $\pm$ 1,02 mm	11,3 $\pm$ 0,9 s	12,6 $\pm$ 1,72
Women	12,01 $\pm$ 1,08 mm	8,4 $\pm$ 1,6 s	26,2 $\pm$ 1,34

As for the interferometry data, in the patients of the second group, a violation of the thickness of the lipid

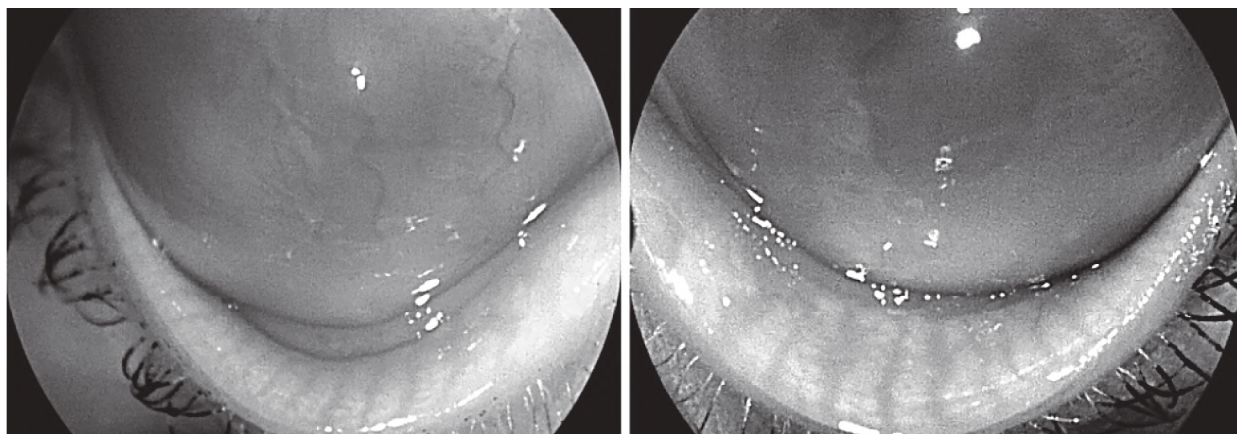


Figure 2 – The condition of the meibomian glands of the lower eyelid of the patient from second group.

layer according to the normal ranges was determined in 17% of cases (4/23).

Figure 2 shows the complete patency of the meibomian glands of the lower eyelid of the patient from second group.

When we compared the results of a specific examination in patients of groups 1 and 2, we found out that TBUT test indicators in women of group 1 were statistically significantly ($p=0.011$) much lower, which means a more severe course of dry eye disease. Results of Schirmer's test give us the same conclusion. Women 1 group of study showed statistically lower ($p=0.0001$) rates of fluorescein staining of the test strips and of course leads to severe manifestations of dry eyes.

Conclusions.

Therefore, when we compared the study groups according to the data of a specific examination for the presence and severity of dry eye disease and also

patient complaints, we found out that the subjects who had SARS-CoV 3-4 months before the examination were more than 2 times more likely to suffer from the manifestations of dry eyes (35 and 78%, respectively), compared to patients with a longer period after recovery.

The degree of dry eye disease was more severe in patients with early recovery – 39% of patients had an average degree of severity of the disease (compared to 4% of cases in the other group) and 4% of patients had a severe stage (no patient in the second group).

It was also found that women suffer from the manifestations of this disease 1.5 times more often than men.

Prospects for further research.

Identify factors and reasons that can affect the occurrence of dry eye, for effective treatment and prevention in patients with coronavirus infection.

References

1. Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet*. 2020;395(10242):1973–1987. DOI: [10.1016/S0140-6736\(20\)31142-9](https://doi.org/10.1016/S0140-6736(20)31142-9).
2. Naser AY, Al-Hadithi HT, Dahmash EZ, Alwafi H, Alwan SS, Abdullah ZA. The effect of the 2019 coronavirus disease outbreak on social relationships: A cross-sectional study in Jordan. *Int J Soc Psychiatry*. 2021;67(6):664–671.
3. Alyami HS, Naser AY, Dahmash EZ, Alyami MH, Alyami MS. Depression and anxiety during the COVID-19 pandemic in Saudi Arabia: A cross-sectional study. *Int J Clin Pract*. 2021;75(7):e14244.
4. Abusamak M, Jaber HM, Alrawashdeh HM. The Effect of Lockdown Due to the COVID-19 Pandemic on Digital Eye Strain Symptoms Among the General Population: A Cross-Sectional Survey. *Front Public Health*. 2022;10:895517.
5. Kaidashev I, Shlykova O, Izmailova O, Torubara O, Tyshchenko Y, Tyshkovska T, et al. Host gene variability and SARS-CoV-2 infection: A review article. *Heliyon*. 2021 Aug;7(8):e07863.
6. Regmi A, Suresh J, Asokan R. Changes in work patterns during COVID-19 lockdown and its impact on the eyes and body. *Clin Exp Optom*. 2023;106(3):331–337.
7. Talens-Estarellles C, García-Marqués JV, Cervino A, García-Lázaro S. Use of digital displays and ocular surface alterations: A review. *Ocul Surf*. 2021;19:252–265.
8. Shimazaki J, Nomura Y, Numa S, Murase Y, Kakinoki K, Abe F, et al. Prospective, multicenter, cross-sectional survey on dry eye disease in Japan. *Adv Ther*. 2020;37:316–328.
9. Kaido M, Kawashima M, Yokoi N, Fukui M, Ichihashi Y, Kato H, et al. Advanced dry eye screening for visual display terminal workers using functional visual acuity measurement: the Moriguchi study. *Br J Ophthalmol*. 2015;99(11):1488–1492.
10. Craig JP, Wang MTM, Ambler A, Cheyne K, Wilson GA. Characterising the ocular surface and tear film in a population-based birth PAPAS | 13 cohort of 45-year old New Zealand men and women. *Ocul Surf*. 2020;18:808–813.
11. Greco G, Pistilli M, Asbell PA, Maguire MG, Dry Eye Assessment and Management Study Research Group. Association of Severity of Dry Eye Disease with Work Productivity and Activity Impairment in the Dry Eye Assessment and Management Study. *Ophthalmology*. 2021;128(6):850–856.
12. Vehof J, Snieder H, Jansonius N, Hammond CJ. Prevalence and risk factors of dry eye in 79,866 participants of the population-based Lifelines cohort study in the Netherlands. *Ocul Surf*. 2021;19:83–93.
13. Okumura Y, Inomata T, Iwata N, Sung J, Fujimoto K, Fujio K, et al. A Review of Dry Eye Questionnaires: Measuring Patient-Reported Outcomes and Health-Related Quality of Life. *Diagnostics*. 2020;10(8):559.
14. McDonald M, Patel DA, Keith MS, Snedecor SJ. Economic and humanistic burden of dry eye disease in Europe, North America, and Asia: a systematic literature review. *Ocular Surf*. 2016;14(2):144–167.
15. Tsuber V, Kadamov Y, Tarasenko L. Activation of antioxidant defenses in whole saliva by psychosocial stress is more manifested in young women than in young men. *PLoS One*. 2014 Dec 19;9(12):e115048.
16. Bhattacharya S, Heidler P, Saleem SM, Marzo RR. Let There Be Light-Digital Eye Strain (DES) in Children as a Shadow Pandemic in the Era of COVID-19: A Mini Review. *Front Public Health*. 2022;10:945082.

РОЗВИТОК ХВОРОБИ СУХОГО ОКА ПІСЛЯ ПЕРЕНЕСЕНОГО COVID-19

Олефір І. С.

Резюме. В 2019 році епідемія COVID-19 сколихнула весь світ і докорінно змінив спосіб життя людей, які скоротили соціальні контакти та проводили більше часу перед екранами гаджетів через карантинні заходи.

Серед офтальмологічних симптомів найбільш часто рапортували про розвиток вірусних кон'юнктивітів, епісклеритів, мікрогеморагій на сітківці, виникнення макулопатій та невритів зорового нерву. Найбільш часто дані симптоми виникали саме під час коронавірусного захворювання. Однак, період відновлення після тяжкої вірусної інфекції, за новітніми даними, також має свої варіанти патологічних офтальмологічних патологій. Одним із них є синдром сухого ока, який викликає значний дискомфорт та навіть зниження працездатності і якості життя, адже, на жаль, не можливий без постійного підтримуючого терапевтичного лікування.

Метою даної роботи було оцінити та порівняти виникнення хвороби сухого ока (ХСО) та його вираженість у пацієнтів після перенесеного SARS-CoV-2 в анамнезі та у пацієнтів, що не мали ознак коронавірусної інфекції більше, ніж 1 рік.

Під нашим спостереженням знаходилось 46 пацієнтів, що були розділені на дві групи у залежності від тривалості перенесеного SARS-CoV-2.

У пацієнтів з раннім терміном після перенесеного COVID-19 було виявлено, що в 78% випадків (18 пацієнтів з 23) спостерігалась прояви ХСО слюзотеча, помірна світлобоязнь, відчуття стороннього тіла та зниження гостроти зору. Вищеперераховані скарги у переважній більшості (52% випадків) виникали у жінок (12/23). У іншій когорті пацієнтів, що мали ознаки коронавірусної інфекції більше ніж 1 рік тому, прояви ХСО були виявлені лише в 35% випадків (8 пацієнтів з 23 обстежуваних даної групи).

При порівнянні груп дослідження за даними специфічного обстеження на наявність та вираженість сухого ока та скарг пацієнтів, було виявлено, що пацієнти, які перенесли SARS-CoV за 3-4 місяці до проведеного дослідження, більше ніж у 2 рази страждають від проявів сухості очей, в порівнянні з особами з більш тривалим терміном після одужання.

Ключові слова: хвороба сухого ока, слізна плівка, інтерферометрія, Covid-19, комп'ютерні пристрої.

DEVELOPMENT OF THE DRY EYE DISEASE AFTER COVID-19

Olefir I. S.

Abstract. In 2019, the COVID-19 epidemic shocked the whole world and fundamentally changed the way of life mostly all people, who reduced social contacts and spent more time in front of gadget screens due to quarantine. Among the ophthalmological symptoms, the development of viral conjunctivitis, episcleritis, retinal microhemorrhages, maculopathies and optic neuritis were most often reported. These symptoms most often occurred during the coronavirus disease. However, the recovery period after a severe viral infection, according to the latest data, also has its own variants of pathological ophthalmic conditions. One of them is dry eye syndrome, which causes significant discomfort and even a decrease in work capacity and quality of life, because, unfortunately, it is not possible to recover without constant supportive therapeutic treatment.

The purpose of this work was to evaluate and compare the occurrence of dry eye disease (DED) and its severity in patients with a history of SARS-CoV-2 and in patients who had no symptoms of coronavirus infection for more than 1 year.

We monitored 46 patients who were divided into two groups depending on the duration of the SARS-CoV-2 infection. In patients with an early period after the transfer of COVID-19, it was found that in 78% of cases (18 of 23 patients), lacrimation, moderate photophobia, foreign body sensation and decreased visual acuity were observed. The above-mentioned complaints in the vast majority (52% of cases) occurred in women (12/23). In another cohort of patients who had symptoms of coronavirus infection more than 1 year ago, manifestations of DED were detected in only 35% of cases (8 patients out of 23 examined in this group).

Therefore, when we compared the study groups according to the data of a specific examination for the presence and severity of dry eye disease and also patient complaints, we found out that the subjects who had SARS-CoV 3-4 months before the examination were more than 2 times more likely to suffer from the manifestations of dry eyes (35 and 78%, respectively), compared to patients with a longer period after recovery.

Key words: dry eye disease, tear film, interferometry, Covid-19, computer devices.

ORCID and contributionship:

Olefir I. S.: <https://orcid.org/0000-0002-9151-2524> ABCDEF

Corresponding author

Olefir Iryna Serhiivna

Poltava State Medical University

Ukraine, 36011, Poltava, 23 Shevchenko str.

Tel.: 0666871079

E-mail: i.olefir@pdmu.edu.ua

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article.

Received 29.09.2023

Accepted 01.03.2024