

Ophthalmic changes in patients with COVID-19: narrative review of studies and case series

Alterações oftalmológicas em pacientes com COVID-19: revisão narrativa de estudos e séries de casos

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ABSTRACT: The objective of this study is to describe clinical cases and series cases related to ophthalmological alterations in patients diagnosed with COVID-19. A narrative/descriptive review of clinical cases and case series was performed. From the data searches with pre-defined descriptors, 17 studies were integrated in the review. Among the main themes identified, the following stand out: conjunctival alterations, retinal alterations and ophthalmoparesis. The picture of conjunctival alterations was prevalent in relation to the others. This review included not only eye disorders in adults, but also in children and adolescents. The study draws attention to the fact that the ocular alterations were described as an isolated alteration, a precipitating alteration and simultaneous alteration in the respiratory condition. It is concluded that eye disorders go beyond conjunctival alterations, although these are preponderant, with retinal alterations, ophthalmoparesis and the unusual Miller Fisher syndrome. New trails will be able to evaluate, in fact the representativeness of eye problems in the epidemiological chain of COVID-19.

Keywords: Eyes; Clinical cases; Conjunctiva; Retina; SARS-CoV-2.

RESUMO: O objetivo deste trabalho é descrever casos clínicos e séries de casos relacionados a alterações oftalmológicas em pacientes com diagnóstico de COVID-19. Foi realizada uma revisão narrativa/descritiva de casos clínicos e série de casos. A partir das buscas de dados com descritores pré-definidos, foram integrados na revisão, 17 estudos. Dentre os principais temas identificados, destacam-se: alterações conjuntivais, alterações retinianas e oftalmoparesias. O quadro de alterações da conjuntiva foi prevalente em relação aos demais. Essa revisão incluiu não apenas afecções oculares em adultos, mas também, em crianças e adolescentes. O estudo chama atenção para o fato de que as alterações oculares foram descritas como alteração isolada, alteração precipitante e alteração simultânea ao quadro respiratório. Conclui-se que as afecções oculares vão além de alterações conjuntivais, embora sejam essas preponderantes, havendo ainda alterações retinianas, quadro de oftalmoparesia e ainda a incomum síndrome de Miller Fisher. Novos ensaios irão poder avaliar, qual é de fato, a representatividade dos problemas oculares na cadeia epidemiológica da COVID-19.

Palavras-chave: Olhos; Casos clínicos; Conjuntiva; Retina; SARS-CoV-2.

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INTRODUCTION

In December 2019, a new disease was reported in Wuhan, Hubei, China, which presented clinically as a viral pneumonia. Therefore, it was shown that the causative agent of this condition was a new type of coronavirus, SARS-CoV-2, an RNA virus belonging to the Coronaviridae family and which has significant mortality rates^{1,2}.

Beyond the respiratory symptoms, it has been pointed out that the coronavirus can also affect other parts of the human body, even causing ophthalmological symptoms, and is often associated with eye diseases such as conjunctivitis².

Ocular changes in patients with COVID-19 are uncommon but present. The relation between eye changes and COVID-19 are still intriguing. There are those who believe that eye involvement is accidental because the eye tissue has a tiny quantity of ACE2, but there is another current that the eyes seem to be a gateway for SARS-CoV-2³. In April of this year, a survey that evaluated a total of 56 patients infected with COVID-19, using evaluating scores to evaluate eye symptoms before and after COVID-19 infection, concluded that one in four patients had greater severity of your eye changes after the beginning of COVID-19. And in about one in 10 individuals, these eye symptoms appear several days before the beginning of fever or respiratory symptoms⁴.

Studies such as reports, case series and cross-sectional studies present information inherent to individuals⁵. The clustering of new and even unusual information is often closely related to epidemic or pandemic situations when brought into the current epidemiological context, especially when both diagnosis and therapeutic issues are not yet well defined in the literature^{5,6}. Reports are understood to be the detailed description of clinical cases, containing important characteristic about the signs, symptoms and other characteristics of the patient⁶.

Describing the results of studies, essentially primary, without going into the merits of the methodological evaluation, or the interface of indicating or not therapy, highlighting the educational and descriptive, contemplates one of the objectives of this type of review. Observing case series or clinical case reviews can allow the reader to get to know and update on topics of their clinical interest in a faster way⁶. Thus, the objectives of this review were to identify and describe clinical cases and case series related to ophthalmological changes in patients diagnosed with COVID-19.

METHODOLOGY

This is a narrative-descriptive review of clinical cases and case related to ophthalmological alteration in patients diagnosed with COVID-19. The databases used

were PubMed/Medline and LILACS. Despite being a narrative review, was chose to use previously elaborated search strategies, using Mesh as a standardization resource (1-6). For LILACS descriptors of Dec were used, although many terms were not identified.

MeSH and individual descriptors used in the databases:

1. (((“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh]) AND “Case Reports” [Publication Type])
2. (((“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh]) AND “Conjunctiva”[Mesh] AND “Case Reports” [Publication Type])
3. (((“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh]) AND “Retina”[Mesh] AND “Case Reports” [Publication Type]))
4. (((“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh]) AND “Retina”[Mesh])
5. (“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh])
6. (((“COVID-19” [Supplementary Concept]) AND “Eye”[Mesh]) AND “Conjunctiva”[Mesh])
7. COVID-19 AND Ophthalmological changes
8. SARS-COV-2* AND EYES*
9. COVID AND CONJUNCTIVITIS*
10. COVID-19 AND ophthalmoparesis.

Furthermore, the selected articles were peer-reviewed. Article searches and selections were not limited to language and period of publication.

RESULTS

From the descriptors used, a total of 134 studies were identified. Were identified 128 studies in PubMed/Medline and 6 in LILACS.

Of these, 17 studies were included in the review. Were excluded 121 articles because they did not meet the objectives of this review (review studies, editorials, studies that did not present details inherent to studies of the clinical case/case series type) and also because they were repeated during the search. Although, for studies of the narrative review type, methodological rigor is not required in principle in ration to the search period, for transparency purposes, the descriptors 1 to 8, the search period occurred until June 20th. However, for descriptor 9, the search ended on July 16th and for descriptor 10, which is also a recent topic, the deadline was July 25th. The justification for using descriptor 9 for a longer period was based on the evident relation between COVID-19 and ocular alteration. All integrated studies came from PubMed/Medline. Were observed 3 repetitions in LILICAS. In PubMed/Medline,

the same case was published in 2 different articles, in this case, one of them was excluded.

In relation to age, among adult patients who presented conjunctival alterations, the mean age was 48 years. Regarding the age of 2 articles related to adolescents, the average age of these was 13,5 years. Among the patients evaluated regarding retinal changes, age ranged between 25 and 69 years of age. Regarding Patients with ophthalmoparesis, the means age was 46,57 years.

In all, 100 people were described in the publications, of which 49 (49%) had a relation between COVID-19 and eye changes (cases confirmed by RT-PCR). Of the 49 cases, 30 were related to conjunctival alterations, 12 to the retina and 7 involved ophthalmoparesis. Among the 30 cases associated with conjunctival alterations, 6 (20%) were in minors.

Regarding the ophthalmological alterations presented, 12 articles mentioned clinical findings compatible with viral conjunctivitis, and only 1 study described retinal alterations.

Of the 9 articles related to conjunctival complaints realized in adults, 2 (22%) observed that conjunctival changes were the only clinical manifestations of COVID-19 (6 patients). On the other hand, 3 articles (33,3%) (3 patients) showed that the ocular changes appeared at least 8 days after the systemic manifestation. Another 2 (22%) studies described cases in which ocular manifestations preceded systemic ones (3 patients). Finally, 2 articles (22%), which addressed 11 people, did not imply that there was a clear interval between ocular and systemic changes, being classified as simultaneous cases. This information refers only to studies realized with adults. Retinal changes can also be considered late.

Regarding the origin of the publications, 4 were from Italy, 4 from China, 3 from the United States, 2 from Spain. Brazil, Argentina, Canada, and France presented only one publication each.

Although at first glance the results seem limited, the descriptions of the studies reveal peculiar and very important clinical information not only for the ophthalmologist but for the general practitioner. When conjunctivitis is mentioned, the idea is that it is a mere inflammation, however, the articles bring current and little known elements about such morbidities.

Retinal changes

The only study identified with the descriptors used on retina was developed in Brazil and published in the Lancet. An exam known as optical coherence tomography (OCT) was used to evaluate the retina of patients with COVID-19. Participated of the evaluation 12 people (6 men and 6 women) aged between 25 and 69 years old. The patients participated of the examination around 11-13 days after the beginning of symptoms. All patients reported

fever, dyspnea and asthenia. Of these, 11 still presented anosmia and 2 patients were admitted to the hospital, but without needed of intensive intervention. All participants were health professionals. Two types of OCT devices were used: OCT – Swept Source and OCT - Spectral Domain⁷.

The conclusion of the authors is that all patients demonstrated hyperreflective lesion at the ganglion cell level and in the inner plexiform layer, being more prominent in the macular papillo region in both eyes. The Angio-OCT and analysis of the ganglion cell complex were normal. Of the patients, 4 also presented a lesion of cotton-wool spots and microhemorrhages along the retinal arcade, observed on funduscopy. Visual acuity and pupillary reflex were also normal⁷.

Conjunctival changes as the only manifestation of COVID-19

The first case to be described is a 72 years old patient, with Type 2 diabetes mellitus (DM) and systemic arterial hypertension (SAH) at first well controlled. This patient and his 66 years old wife were aboard a cruise ship when they were surprised by a screening process for SARS-CoV-2. Although asymptomatic, the 72 years old was positive for the virus. Given the regime imposed on the ship the couple cannot separate⁸.

During the period, the patient began to present a picture of conjunctivitis, with photophobia, eye irritation and secretion. The report of this patient emphasizes that the ocular alteration was the only manifestation of COVID-19, describing binocular conjunctivitis as severe, characterized by intense hyperemia, edema, conjunctival chemosis, fibrin pseudomembranous and inflammatory cell in the tarsal conjunctiva associated with pre-conjunctival lymph nodes and enlarged auricular and submaxillary. Topical therapy was prescribed, consisting of a cold compress, artificial tears without preservatives and a local antiviral gel based on ganciclovir five times a day for seven days. It is worth noting that his wife, although also elderly, did not show any changes in the disease⁸.

Another publication follows the same reasoning when describing that conjunctivitis can be an isolated sign of COVID-19 infection. This report describes 5 patients who presented conjunctivitis as the only sign of viral infection, being 4 men and one woman, with a mean age of 46.8 years. All patients reported having traveled to places where the incidence of the disease was high. They tested positive for the virus but did not develop fever, malaise or respiratory symptoms during the course of their illness. All recovered completely. The authors used the term atypical to describe cases like these. The authors emphasize that the ocular alteration in the context of the pandemic should not be overlooked, and may in fact be the only organic manifestation of the infection⁹.

Late conjunctival changes

In February of this year, a man with a sore throat and diarrhea came to a Chinese hospital, reporting previous contact with a COVID-19 patient. The authors described that despite the symptoms not being “remarkable”, they performed PCR due to previous contact with a positive patient. After confirmation of the virus, the patient was hospitalized and received lopinavir and ritonavir tablets administered from the sixth day of hospitalization¹⁰.

On the 13th day of illness, the patient reported erythema, foreign body sensation and tearing in both eyes. Denying direct eye contact. Slit lamp examination identified moderate bilateral conjunctival injection, watery discharge, lower palpebral conjunctival follicles, and tender, palpable preauricular lymph nodes. No lesion was detected in corneal or anterior chamber inflammation. Macular thickness and optical coherence tomography measurements were within normal ranges¹⁰.

Although, conjunctival swab samples proved positive for SARS-CoV-2. Ribavirin eye drops were prescribed to be administered four times a day. On the 15th day of the disease, there was an improvement in the symptoms and ocular signs. Ocular PCR was negative around six days after the first collection. The authors made it clear that the amount of virus identified in the eye was moderate and much lower than that expected from the nasopharyngeal region¹⁰.

This next report describes a 63 years old man who was admitted to the ICU after initially presenting with influenza like symptoms, with imaging changes of interstitial pneumonia. On the 19th day of hospitalization, he started to present ocular alterations (petechiae hemorrhage, mucous filaments and tarsal pseudomembrane). The authors of this research highlighted a data that has already been observed in previous descriptions: emergence of ocular manifestations around 14 days after the onset of respiratory symptoms¹¹.

To support the theory that eye changes can also arise after the onset of classic symptoms of COVID-19, a 53 years old man stands out who after eight days of respiratory changes, complained of pain in the left eye demonstrating lower eyelid edema, bulbar conjunctival hyperemia accompanied by a large amount of watery secretions and also, a small amount of thin viscous secretions in the left eye. The presence of SARS-CoV-2 in the ocular tissue was also observed, which lasted until the first day after being treated with levofloxacin hydrochloride and 0,1% of sodium hyaluronate¹².

Subsequent tests for the virus in the eyes were negative. The eye treatment was suspended and the patient was discharged home with guidance to maintain the quarantine. However, approximately 14 days after the onset of symptoms, when he was examined again, the condition worsened, with spots observed on the periphery of the corneal epithelium of both eyes. A significant increase in IL 6 was identified in the left eye, which was treated with

0,1% of fluorometholone, with an important improvement in the picture following¹².

Ocular changes preceding systemic changes

A 48 years old man with a history of ocular hyperemia and watery discharge in the eye associated with a foreign body sensation for five days searched the ophthalmology service. When questioned, the patient reported an intermittent dry cough and mild fever in the last three days. Clinical history and slit lamp examination were consistent with viral conjunctivitis in the right eye. A chest X-ray showed increased bronchovascular staining without definitive signs of pneumonia. The patient was admitted for observation and received topical tobramycin-dexamethasone in the affected eye. Given the normalization of temperature and improvement of respiratory and ocular symptoms, the patient was discharged after three days of observation and home isolation for 14 days was advised¹³.

Telemedicine was used in this report related to ocular alteration. A 27 years old man was treated in Argentina via telemedicine with the ophthalmologist, from the complaint of “feeling of a foreign body and red left eye”. The patient did not present epiphora, secretion or decreased vision. Personal history was not remarkable and he was a non-smoker sportsman. External examination revealed unilateral eyelid edema and moderate conjunctival hyperemia. A topical combination of antibiotics and corticosteroids was prescribed¹⁴.

Subsequently, the patient presented intense headache and fever of 39°C, evolving 12 hours later with cough and severe dyspnea, which compromised speech. The RT-PCR of nasopharyngeal swabs was positive for SARS-CoV-2. Eleven days later, a second telemedicine consultation showed that the ocular signs had resolved. In this second moment, dyspnea and cough were less severe, but still present. According to the authors, this case illustrates the interest of telemedicine in ophthalmology during the COVID-19 pandemic, since moderate conjunctivitis can be the first sign of a severe respiratory disorder¹⁴.

Systemic symptoms and apparently simultaneous eye changes

A Canadian woman of 29 years old who had her vacation in the Philippines came to the eye service with a history of conjunctivitis in the right eye, photophobia, and clear watery discharge. In this case, the ocular alteration was not the only clinical manifestation. Rhinorrhea, cough and nasal congestion were also reported. Denied fever, although had used antipyretic¹⁵.

Before being attend by the ophthalmologist, was previously seen by the family doctor. On ocular examination, a visual acuity of 20/20 was observed. Examination of the anterior segment of the affected eye was notable for 1-2 + conjunctival injection 3 + follicles,

a small pseudodendrite in the inferior temporal cornea, and eight smalls (0,2 mm) subepithelial infiltrates with overlying epithelial defects in the superior temporal limbus. The patient was prescribed oral valaciclovir 500 mg and moxifloxacin based on a presumed diagnosis of herpetic keratoconjunctivitis¹⁵.

Two days after the first ophthalmologic evaluation, the symptoms (erythema, pain and irritation) worsened. A right preauricular node was observed. On slit lamp examination, conjunctival injection was observed, along with a change in corneal appearance, showing the development of numerous subepithelial infiltrates with underlying epithelial defects. Shortly after fluorescein instillation, there was only spot staining with associated underlying epithelial defects in the temporal cornea. The patient continued to use oral valaciclovir and moxifloxacin drops¹⁵.

The patient returned to the ophthalmologist due to persistent worsening of symptoms and decline in vision. On this visit in the right eye was 20/40 to 20/30. A new slit lamp examination of the eye revealed follicular conjunctival injection and more than 50 discrete areas of subepithelial infiltrates with underlying epithelial defects, diffusely defects spread throughout the cornea. The diagnosis of COVID-19 was only made after a few days of symptoms¹⁵.

A case series published in JAMA involving 38 people, with a mean age of 65,8 years old, observed that of these, 28 (73,7%) had positive findings for COVID-19 on nasopharyngeal RT-PCR. Twelve patients (31,6%; 95% CI, 17,5 – 48,7) had ocular manifestations consistent with conjunctivitis, including conjunctival hyperemia, chemosis, epiphora, or increased secretions. By univariate analysis, patients with eye symptoms were more likely to have higher white blood cell and neutrophil counts and also higher levels of procalcitonin, C-reactive protein, and lactic dehydrogenase than patients without eye symptoms¹⁶.

Furthermore, 11 of 12 patients with ocular abnormalities (91,7%; 95 CI, 61,5 – 99,8) tested positive for SARS-CoV-2 on RT-PCR of nasopharyngeal swabs. Of these, 2 (16,7%) had positive results in both conjunctival and nasopharyngeal swabs. One point that the authors presented in the conclusion is that, although uncommon, the transmission of SARS-CoV-2 through tears is a reality¹⁶.

Eye changes in children and adolescents

A two years old child who tested positive for SARS-CoV-2, after the seventh day of confinement, presented with conjunctivitis and eyelid dermatitis and was referred to the hospital service. Admission tests reconfirmed SARS-CoV-2 infection by RT-PCR, meanwhile revealed myocardial damage and atypical change in lymphocyte count with normal chest CT¹⁶.

After treatment, as per Chinese protocol, conjunctivitis and eyelid dermatitis gradually disappeared

after 5 days. From 10 to 12 days of admission, had a negative viral nucleic acid result with a positive Igg result, but negative IgM of the virus in the serum, indicating that the virus was eliminated. Subsequently, the child was discharged from the hospital¹⁶.

Still in the pediatric context, this study is a case series that involved 27 children admitted to hospital in the Vatican, of which 20 tested positive for SARS-CoV-2. On admission, 23 patients were symptomatic: 15 (56%) patient had respiratory symptoms and 8 (30%) had gastrointestinal symptoms, with or without fever¹⁷.

This study reports that 4 children out of 27 (15%) had eye changes consistent with viral conjunctivitis, characterized by mild hyperemia and conjunctival secretion; of these, one patient was positive for SARS-CoV-2 on RT-PCR of conjunctival swab, while no signs of viral shedding were found in the other three. Clinical resolution of conjunctivitis was achieved in all patients 3-5 days after the beginning. A further 2 patients tested positive for SARS-CoV-2 on conjunctival swab without developing clinical signs¹⁷.

The next report refers to the case of two teenagers. Before going into the clinical merits, itself, the authors reported that the condition present by both, until then, was somewhat unknown, alerting the medical community about more complex manifestation¹⁸.

The first adolescent, aged 12 years with a history of seasonal allergies, developed a unilateral progressive painful orbital edema, being transferred to a specialized service after parental use of vancomycin and ceftriaxone. The physical findings presented included preserved acuity, however, there was partial defect of the afferent retina, severe eyelid edema on the right, with mild erythema, requiring digital force to open the eyelids, mild/moderate unilateral non-hemorrhagic conjunctival chemosis, proptosis of 3 to 4 mm and severe limited supraduction. Nasal congestion was reported by the patient for two weeks, denying fever¹⁸.

The imaging exam showed ipsilateral frontal, maxillary and anterior ethmoid sinusitis and hyperdense material in the sinuses, associated with a complex extraconal subperiosteal fluid collection. The patient underwent superior orbitotomy with drainage of subperiosteal mucus with bacitracin/polymyxin irrigation. In the postoperative period, the patient showed clinical improvement with parental use of antimicrobials such as vancomycin, in addition to the topical use of tobramycin¹⁸.

In turn, the second case is about a 15 years old boy diagnosed with asthma, who developed progressive painful orbital edema, mild rhinorrhea, diarrhea, painful muscle spasms and vomiting. A low-grade fever was followed by fever spikes. Regarding the ocular examination, the patient had severe periorbital edema of the upper and lower eyelids on the right side, requiring force to manually open the eyelids. Discharge, mild non-chemotic conjunctival

hyperemia, moderate deficit of supraduction and proptosis of the right eye. Opacification of right paranasal sinus was observed. The sinuses were filled with hypodense fluid, with evidence of right periantral fatty invasion. Thrombophlebitis of right superior ophthalmic vein (SOV) was also observed¹⁸.

Moderate respiratory decompensation occurred 48 hours after admission. After the surgical intervention, the clinical course was marked by persistent fever, moderate and diffuse worsening of ocular motility, increase in conjunctival chemosis with small areas of hemorrhage, episodes of dyspnea and mild chest pain with brief desaturations for 89% (not requiring ventilation mechanics)¹⁸.

The patient was maintained on parental vancomycin, ceftriaxone, metronidazole, enoxaparin, hydroxychloroquine, zinc, vitamin C, and thiamine. Adjuvant treatments included ocular use of tobramycin, nasal fluticasone and oxymetazoline for seizure prophylaxis. His pulmonary decompensation remained limited in extent. He remained feverish on continuous course of broad-spectrum intravenous antibiotics, with virtually resolution of his orbital findings and stability of his small collection of epidural fluids¹⁸.

Miller Fisher Syndrome and Ophthalmoparesis

Miller Fisher syndrome is characterized by the acute onset of ophthalmoplegia, ataxia and loss of tendon reflexes¹⁹. In relation to this syndrome, 2 cases were observed, in different articles, in 2 men, one aged 50 and the other aged 39.

Both patients had oculomotor paresis with a positive test for GB1b-IgG antibodies. These neurological manifestations can occur due to a wrong immune response to COVID-19. The full clinical spectrum of neurological symptoms in COVID-19 patients still needs to be better understood²⁰.

DISCUSSION

Despite few studies, this review has its academic value in the sense of imprinting the clinical relation between COVID-19 and ocular tissue. Conjunctivitis was the most cited manifestation, even being, in some cases, the only symptom presented. In the literature, the prevalence of conjunctivitis in patients with COVID-19 was observed in 11,6% of the people evaluated²¹.

A meta-analysis carried out through studies that included only Chinese people observed that conjunctivitis may be associated with a more severe picture of COVID-19²². However, this affirmation was not confirmed in this review study that evaluated a similar outcome²¹.

This information is important, since despite the conjunctival alteration having been prevalent among

the identified articles, the atypical term regarding ocular alterations seems to be defended by some researchers. Within this position, it is important to highlight the relation between the ocular tissue and the pathogenic fact of SARS-CoV-2, although different authors agree that the eyes are unlikely to be transmission routes for the virus in question, since there is no a consensus on whether indeed ACE2 is widely expressed in the human conjunctiva whether diseased or healthy²³.

However, it is not possible to completely rule out the probability of viral particles being present in tears, although nothing can be confirmed yet^{3, 24}. Twenty-eight professionals directly involved with ophthalmology from 10 Chinese hospitals were diagnosed with COVID-19, with eight patients progressing to severe cases, with three deaths of ophthalmologists who worked in the same hospital. An important information is that only five patients reported having symptomatic family members with COVID-19. The incidence of COVID-19 in professionals working with eye health was 2,52%. Although this study involved a small number of patients, this article needs to be considered in the reflective-epidemiological context²⁴.

As presented in this review, different authors demonstrate in their research the presence of the virus in the tear or in the conjunctival pouch, although it should be noted that the prevalence of these findings is apparently insignificant^{24,25,26}. Even with different results, the COVID-19 infection through the ocular route is still an uncertainty, but that does not mean that protective measures, which include avowing raising the hands to the eyes, should be forgotten or disregarded²⁷.

Regarding age, although the general average of affected patients identified in this review was not so high, a study that evaluated the presence of eye alterations among health professionals involved with ophthalmology observed that those who get sick, when compared to the control group, were more older people ($p=0,01$), in addition, also had more contact with the unhealthy environment that is the health service²⁴.

The inclusion of this information in the discussion, may in the future, serve to better understand the role of ocular tissue in this epidemiological cycle, remembering that in one of the cases mentioned, the 66 years old wife of that 72 years old man who acquired conjunctivitis on the ship, did not come to complete the same picture of her husband. Of course, it is an extremely isolated and scarce data, but this information, one day added up, can help in some evidence-based answer.

The ocular changes, until now, do not seem to have been limited to the retina and conjunctiva. Miller Fisher syndrome and ophthalmoparesis have also reported, being largely anticipated by respiratory symptoms²⁸. There is still a lack of evidence to justify these changes, although evidence is starting to point to a neurotropism as a characteristic of the coronavirus²⁹.

FINAL CONSIDERATIONS

This review allowed a greater compression in a descriptive tone, of the relation COVID-19 and ocular tissue. Many questions still need to be answered, which of course should occur over time.

However, it is observed that eye disorders go beyond conjunctival alterations, although these are preponderant, with retinal alterations, ophthalmoparesis

and even the uncommon Miller Fisher syndrome. New trials will be able to assess what is, in fact, the representativeness of eye problems, in the epidemiological chain of COVID-19. In this context, it is essential that research be encouraged to understand the relation between eye problems and COVID-19, as many studies have already portrayed this relationship. Thus, we can more easily treat the symptoms associated with this disease, preventing many from developing.

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