



The hidden ophthalmic dangers of steroids in COVID-19 treatment: a case report

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Background: Coronavirus disease 2019 (COVID-19) has been coexisted with us, and corticosteroids are now recommended for patients with severe COVID-19 respiratory failure. Steroid treatments may increase intraocular pressure (IOP) and steroid-induced glaucoma (SIG). This study reported a rapid IOP elevation in a COVID-19 pneumonia child treated with systemic steroids within 3 days. Steroid-induced ocular hypertension (SIOH) during pneumonia treatment has not been previously reported.

Case Description: The 6-year-old Chinese girl was diagnosed with COVID-19 and presented with pulmonary exudative lesions. Intravenous steroid (methylprednisolone, 1 mg/kg/12 h) was administered to control the inflammatory reaction on the fourth day post-infection. The child complained of ocular pain in the left eye (OS) after 3 days of steroid application. A high IOP of 40 mmHg in the right eye (OD) and 60 mmHg (OS) was detected. Following the exclusion of elevated IOP secondary to COVID-19 infection, SIOH was considered as a potential etiology. The IOP was effectively controlled through prompt tapering of systemic steroids and the immediate initiation of IOP-lowering therapy, including intravenous mannitol and topical antiglaucoma medications.

Conclusions: Clinicians treating COVID-19 in hospitals should pay attention to SIOH or SIG risk, especially in pediatric patients.

Keywords: Intraocular pressure (IOP); ocular hypertension (OH); steroid; coronavirus disease 2019 (COVID-19); case report

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Introduction

Intraocular pressure (IOP) elevation after steroid use was first described in 1954 (1) and is well-documented now (2-4). Glaucomatous optic neuropathy can develop if IOP is elevated and untreated. This is known as steroid-induced glaucoma (SIG) (5). Topical and systemic steroid administration can lead to ocular hypertension (OH) or glaucoma, and the systemic route is responsible for

approximately one-fourth of all cases (6).

Compared with adults, children are more likely to suffer from steroid-induced OH (SIOH) or glaucoma (4,6,7). Among the children who progressed to SIG, one-third were bilaterally blind, and one-third were blind in one eye when they were referred to the glaucoma clinic (8). The ocular hypertensive response to steroids in pediatric patients occurs more frequently, severely, and rapidly than in adults (9),

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and it is important to monitor IOP of the children treated with steroids.

The coronavirus disease 2019 (COVID-19) pandemic has swept the world since early 2020 and seriously threatens countless lives. Unfortunately, COVID-19 may coexist with us for a long time. Typically, corticosteroids are now recommended for patients with severe COVID-19 respiratory failure (10,11). This study reported a rapid IOP elevation in a COVID-19 pneumonia child treated with systemic steroids within 3 days. This case suggests that clinicians should pay more attention to SIOH during COVID-19 treatment, as well as in any child case requiring high-dose steroid treatment. We present this case in accordance with the CARE reporting checklist (available at <https://tp.amegroups.com/article/view/10.21037/tp-24-443/rc>).

Case presentation

The 6-year-old Chinese girl diagnosed with COVID-19 presented with pulmonary exudative lesions. Intravenous steroid (methylprednisolone, 1 mg/kg/12 h) was administered to control the inflammatory reaction on the fourth day post-infection. The child complained of ocular pain in the left eye (OS) after 3 days of steroid application. The pain increased 2 days later (day 3 of experiencing eye pain), and the throat swab polymerase chain reaction (PCR) for the COVID-19 virus was negative on the same day.

Ophthalmologic consultation was performed. IOP measured using iCare tonometry (Icare USA Inc., Raleigh, NC, USA) was approximately 40 mmHg in the right eye (OD) and 60 mmHg (OS). The visual acuity was 20/20 in

both eyes. The pupils were 3 mm in diameter and were reactive to light. Slit-lamp examination revealed a bilateral clear anterior chamber with normal depth and no cells (*Figure 1*). The chamber angles were open without pigment deposition (*Figure 1*). No keratic precipitates, lens opacity, vitreous opacity or vitreous hemorrhage was found in both eyes. No optic nerve atrophy or pale optic disc was observed, and cup-to-disc (C/D) ratio was 0.2 in both eyes (*Figures S1-S3*). Corneal thickness was 555 μ m (OD) and 572 μ m (OS). The ocular axial lengths were 21.74 mm (OD) and 21.95 mm (OS). No retinal nodules, hemorrhage, necrosis, or exudation was found in ultrawide field fundus imaging (Daytona, Optos, UK) (*Figures S1-S3*). Optical coherence tomography revealed normal peripapillary retinal nerve fiber layer thickness in both eyes (*Figures S1-S3*). Perimetry data were unavailable for this young child. The child has no family history of glaucoma, no prior eye diseases, and normal vision without high myopia or hyperopia.

After a detailed ophthalmic examination, intravenous mannitol [5 mg/kg/every 8 h (q8h)] was administered immediately. Topical eye drops containing latanoprost and fixed combinations of brinzolamide and timolol maleate were applied to control IOP. However, IOP was 40.7 mmHg (OD) and 56 mmHg (OS) the next day (day 4). Subsequently, the methylprednisolone dose was rapidly reduced to 1 mg/kg/d (day 6) and 0.5 mg/kg/d (day 7), which was discontinued on day 9. IOP decreased to 25 mmHg (OD) and 25 mmHg (OS) (day 9). IOP gradually decreased to normal on day 11. Stepwise withdrawal of IOP-lowering medications (mannitol and topical eye drops) was applied. As the poor pulmonary function had not yet improved remarkably, a low dose of Intravenous steroid [methylprednisolone, 0.5 mg/kg/once a day (qd)] was added again, which was gradually tapered over a period of 1 month. During this period, IOP was within normal limits, and the topical IOP-lowering drugs were withdrawn altogether after corticosteroid cessation. The clinical timeline is illustrated in *Figure 2*.

This study was approved by the Institutional Review Board of the Children's Hospital of Fudan University [IRB No. (2023)19]. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the mother of the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office

Highlight box

Key findings

- This study reported a rapid intraocular pressure elevation in a coronavirus disease 2019 pneumonia child treated with systemic steroids within 3 days.

What is known and what is new?

- Systemic use of steroids can cause steroid-induced ocular hypertension (SIOH) or glaucoma.
- SIOH during pneumonia treatment has not been previously reported.

What is the implication, and what should change now?

- Respiratory physicians treating pneumonia in hospitals should be aware of SIOH risk, especially in pediatric patients.

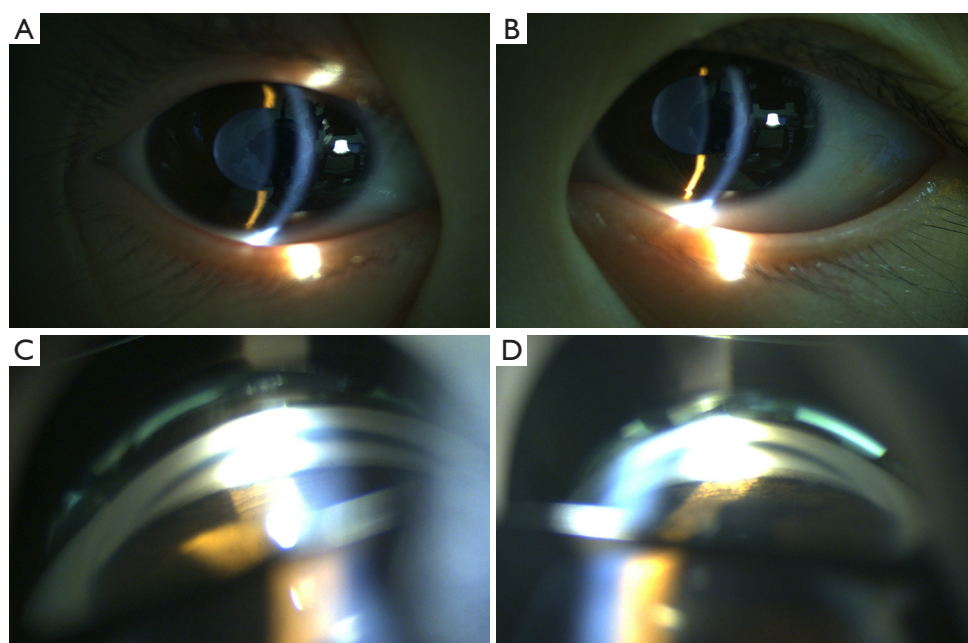


Figure 1 Images of the anterior segment of this child. (A,B) Slit-lamp examination revealed a bilateral clear anterior chamber with normal depth. (C,D) Gonioscopy revealing an open angle without pigment deposition.

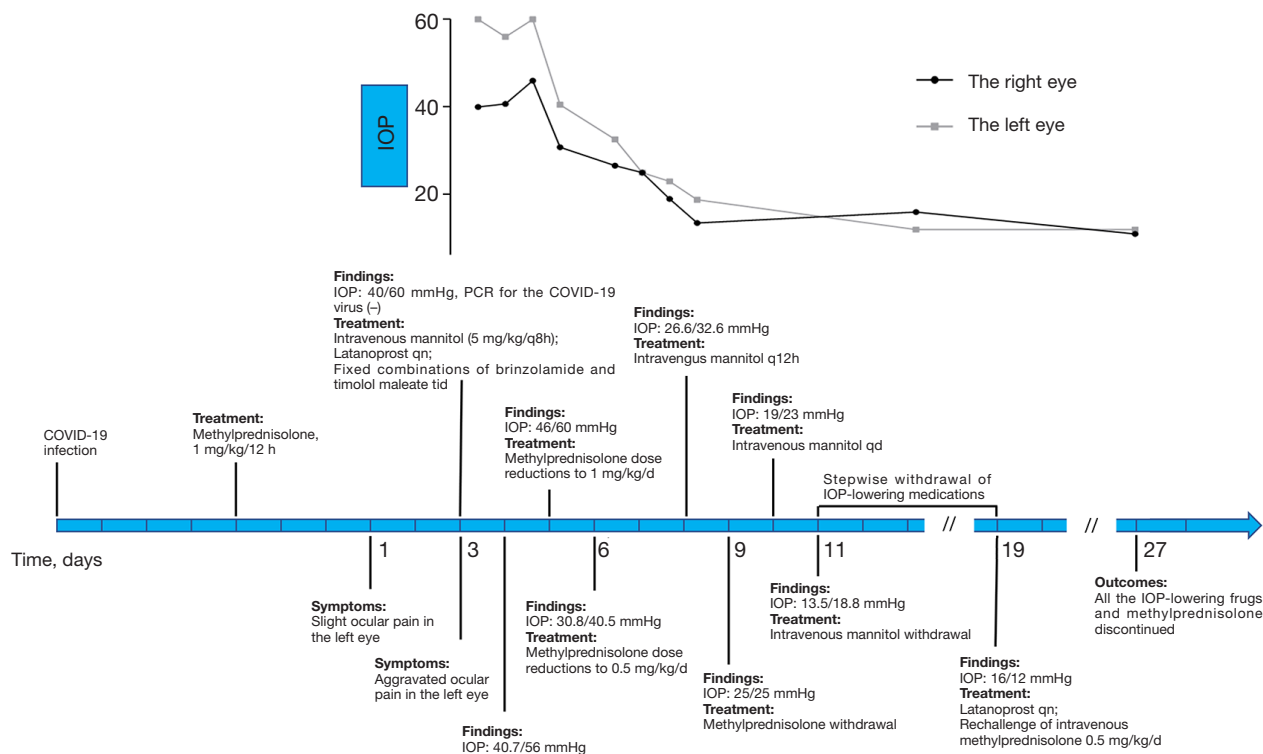


Figure 2 Time line of clinical events. COVID-19, coronavirus disease 2019; IOP, intraocular pressure; PCR, polymerase chain reaction; q8h, every 8 h; q12h, every 12 h; qd, once a day; qn, every night; tid, three times a day.

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Discussion

As a viral disease, COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and primarily affects the respiratory tract. Ocular involvement in COVID-19 accounted for approximately 10–24% (12,13), and conjunctivitis-related symptoms were the most frequent manifestation (13,14). COVID-19-associated retinopathy has also been frequently described in case reports and small series of patients (15–19).

However, there are few studies on COVID-19-associated glaucoma. Özmen *et al.* reported three cases of acute angle-closure glaucoma in the background of hyponatremia due to COVID-19 infection (20). Neovascular glaucoma (NVG) secondary to COVID-19-induced retinal vasculitis was found in a 50-year-old male patient (21). Uncommon OH caused by COVID-19-related bilateral acute depigmentation of the iris was reported by Gaur *et al.* in 2022 (22). To date, there is no data in the literature on the direct links between COVID-19, IOP, and glaucoma.

In this case, around the time the patient began to experience eye pain, the virus nucleic acid of COVID-19 turned negative. No signs of ocular inflammation or infection were noted. Gonioscopy displayed open anterior chamber angles without neovascularization or pigmentation, which was not the case as previously reported.

Accordingly, our final diagnosis for the cause of OH was steroid-induced hypertension. The patient gradually improved after steroid tapering and IOP-lowering medication treatment. To the best of our knowledge, this is the first report of SIOH in a patient with COVID-19. Although the risk is lower than that of the topical route, systemic steroid administration has been proven to cause SIOH or SIG (5,8,23). Children are more likely to have an ocular hypertensive response than adults (23,24). Among the reported cases, SIOH can occur in children, and IOP can reach 40–60 mmHg within a week (23,25–28). In a prospective cohort study, systemic treatment of children with glucocorticoid (prednisolone-equivalent >0.5 mg/kg/d) for more than 2 weeks caused an IOP increase in 56% of the cases, and 12% of the cases were high responders with peak IOP between 32 and 44 mmHg (29). Several studies have suggested that the risk of SIOH is related to the treatment duration and dosage (9,30–33). However, there seems to be no association between IOP and the duration of treatment or dose of steroids in recent studies focusing on

the systemic route of administration in children (29,34,35). Age and ethnicity, as speculated by Krag *et al.*, appeared to be the main risk factor of SIOH in children (29). Furthermore, children less than 6 years of age are considered more susceptible to SIOH and SIG (4,5). In this case, the 6-year-old child experienced a significant elevation in IOP as early as on the day 3 post intravenous steroid administration at a high dose (1 mg/kg/12 h). This rapid elevation of IOP in children is rare but not uncommon and requires close monitoring.

Notably, most children with SIOH or SIG present asymptotically at first (29,33). Headache, more often than ocular pain, is the most common complaint among the systematic population (29,33), which might be attributed to other causes (25). For pediatric patients, limitation in expressing their symptoms is one of the reasons for a high rate of asymptomatic cases. Consequently, active and aggressive monitoring for IOP should be applied in children treated with steroids. However, measuring IOP in children can be relatively challenging. For those who are cannot cooperate with non-contact tonometry, a handheld tonometer can be used to measure the IOP after sedation.

Systemic steroid therapy is commonly used in children with non-ophthalmic diseases such as acute lymphoblastic leukemia, nephrotic syndrome, and inflammatory bowel disease. The children suffering from these diseases may receive long-term steroid treatment rather than high doses, which could also cause SIOH. IOP monitoring is easily overlooked by doctors from these clinical departments. As a new challenge to the health of humankind in recent history, recognition and awareness of the treatment of COVID-19 kept going deeper. Therapy with corticosteroids targets hyperinflammation, also called a cytokine storm in COVID-19 infection, has been proven to have a mortality benefit (10,36). Doctors focusing exclusively on the disease might easily ignore this insidious iatrogenic complication of SIOH or SIG. In most cases, IOP is reduced to normal after prompt cessation of systemic corticosteroids (24,25,37). However, prolonged use of corticosteroids can lead to irreversible glaucomatous optic neuropathy and even blindness (8).

Conclusions

We reported a rapidly elevated IOP in a COVID-19 pneumonia child treated with a high dose of intravenous steroid within 3 days. Clinicians treating COVID-19 in hospitals should be aware of SIOH or SIG risk, especially in

pediatric patients.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://tp.amegroups.com/article/view/10.21037/tp-24-443/rc>

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