Case Report: Herpes Simplex Virus Type 2 Acute Retinal Necrosis With Viral Encephalitis in Children

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Background: Few cases concerning acute retinal necrosis with viral encephalitis in children have been reported, especially cases where the fundus cannot be identified due to severe vitreous opacity in the early stage that makes diagnosis difficult.

Methods: We conducted a retrospective review of an unusual case of herpes simplex virus-2 (HSV-2) acute retinal necrosis with viral encephalitis in an immunocompetent child, along with a review of relevant literature published up to September 2021.

Result: An 11-year-old girl presented with an approximate 20-day history of ocular redness and decreased visual acuity in the left eye. Examination revealed anterior uveitis and vitreous opacity in the left eye. An anterior chamber tap was performed because the fundus could not be observed clearly, and the aqueous humor was positive for HSV-2 DNA. Cerebrospinal fluid also tested positive for HSV-2. She was diagnosed with acute retinal necrosis syndrome and viral encephalitis. The condition was controlled with timely antiviral and steroid therapy. She was also treated with prophylactic laser therapy to prevent retinal detachment during subsequent follow-up. The pathogenesis, diagnosis, and treatment of HSV-2 acute retinal necrosis in children and the association between acute retinal necrosis and viral encephalitis are further discussed, based on published literature.

Conclusion: HSV-2-related pediatric acute retinal necrosis may be due to the acquisition of subclinical infection with HSV-2 during parturition, followed by reactivation of the virus latent in the body on account of certain factors. Moreover, it may be complicated with viral encephalitis. For suspected cases with invisible fundus, early intraocular fluid examination is especially helpful for differential diagnosis. Early diagnosis, early treatment, and timely prophylactic laser treatment to prevent retinal detachment are key to a better prognosis. Physicians need to pay attention to such suspected cases during diagnosis and treatment.

Keywords: herpes simplex virus-2, immunocompetent population, viral encephalitis, vitreous opacity, retinal necrosis

INTRODUCTION

Acute retinal necrosis (ARN) syndrome is a viral infectious disease, clinically characterized by severe and extensive uveitis, vitritis, retinal vasculitis, retinal necrosis, and retinal detachment, which in combination indicate an advanced disease stage (1). ARN has an acute onset and rapid progression, and can develop at all ages. However, ARN is relatively more common in adults than
in children (2). Here, we present a child with ARN, viral encephalitis, and herpes simplex virus-2 (HSV-2) infection and a literature review of HSV-2 ARN in children.

MATERIALS AND METHODS

We present a case report of ARN with viral encephalitis in an immunocompetent child with HSV-2 infection. We also performed a PubMed database search of relevant publications in English up to September 2021, using the following keywords: “acute retinal necrosis,” “children,” and “herpes simplex virus” joined by the operator “AND.” We evaluated and reviewed all relevant literature and relevant reported cases.

CASE DESCRIPTION

An 11-year-old girl was admitted to our hospital with an approximate 20-day history of ocular redness and decreased visual acuity in the left eye. On admission, her best-corrected visual acuity (BCVA) was 20/20 in the right eye, and hand motion in the left eye. The patient's intraocular pressures were 19 mmHg and 28 mmHg in the right and left eyes, respectively. Slit-lamp examination revealed conjunctival hyperemia, mild corneal edema, mutton-fat keratic precipitates in the middle and below the corneal endothelium, 3+ cells and 3+ flare in the anterior chamber (Figure 1A), and severe vitreous opacity in the left eye. The fundus could not be inspected because of the vitreous opacity (Figure 2A). Slit-lamp and fundus examinations of her right eye were unremarkable. Ultrasoundography showed severe vitreous opacity, posterior vitreous detachment in the left eye, and thickening of the posterior wall of the left eyeball (Figure 1B). Serological test results for toxoplasmosis, rubella, cytomegalovirus (CMV), and herpes simplex virus indicated that the patient tested positive for HSV-2 immunoglobulin G (IgG), CMV IgG, and rubella virus IgG, and tested negative for other infections. The results of routine blood tests, liver function, renal function, syphilis, tuberculosis, and other laboratory tests showed no significant abnormalities. Granulomatous panuveitis was considered, and differential diagnoses included viral or bacterial infection and toxoplasmosis or Toxocara canis infection.

After informed consent was obtained from her parents, a left eye anterior chamber tap was performed. The aqueous humor results were positive for HSV-2 DNA. Brain magnetic resonance imaging (MRI) scans showed abnormal signal intensity in the right temporal lobe, and dilatation of the right temporal horn when compared with the left temporal horn. After consultation with pediatricians, we performed a lumbar puncture and the cerebrospinal fluid tested positive for HSV antibodies.

According to Classification Criteria for Acute Retinal Necrosis Syndrome (3) key diagnostic criteria, our patient was diagnosed with ARN. She was also diagnosed with viral encephalitis (HSV-2), based on positive test results for HSV antibodies in the cerebrospinal fluid and on brain MRI results. Treatment included administration of intravenous acyclovir and dexamethasone, local steroid eye drops, and mydriasis eye drops. In addition, she received intravitreal ganciclovir injections twice a week for 2 weeks.

Following 3 weeks of treatment, the anterior inflammation was under control, and the left fundus could be gradually observed. Optical coherence tomography (OCT) and wide-field fundus photography showed optic disc edema, macular edema, and peripheral retinal necrosis (Figures 2B, 3A). The recommended time for antiviral therapy has been reported to be between 12 and 14 weeks (4). However, long-term use of antiviral drugs in children may have side-effects such as nephrotoxicity, gastrointestinal upset, and skin lesions (5). Further to a conversation with the patient's parents, they consented to her continuing prophylactic anti-viral therapy; and renal function, blood routine results were closely monitored. She was discharged with a prescription for oral steroids and valacyclovir.

At 2 months, peripheral retinal proliferation was observed in the fundus examination, and the patient was administered prophylactic laser treatment (Figures 2C, 3B). Steroids and valacyclovir were discontinued after 3 months. At the last follow-up, her BCVA was 20/100 in the left eye, and the retina was attached but still had cystoid macular edema on OCT (Figures 2D, 3C).

DISCUSSION

ARN syndrome is a serious viral infectious disease, and its main pathogenic viruses are varicella zoster virus (VZV), herpes simplex virus types 1 or 2, CMV, and the Epstein-Barr virus (EBV) (6–8). ARN can occur in both adults and children; however, it occurs more commonly in adults, with an average age of onset reported to be between 20 and 60 years (9). Several studies have reported that adult ARN is mainly due to VZV and HSV-1 (10). In contrast, there are significantly fewer reports related to pediatric ARN, and the main causative virus has been reported to be HSV-2 (11–13).

We reviewed the relevant literature concerning ARN, and identified 14 cases of pediatric ARN due to HSV-2 (10, 14–23). Pediatric ARN due to HSV-2 was first reported in 2001 (14). Details concerning 15 cases (including the present case)
are summarized in Table 1. The median age of the 15 children was 6.59 years (range, 23 days to 14 years) with no sex predominance (7 boys; 8 girls). Of these 15 patients, 11 patients had unilateral disease and 4 patients had bilateral disease. The fundus of one patient could not be observed due to synechiae between the pupil and the lens, whereas our patient had severe vitreous opacity resulting in an inability to observe the fundus. All the other patients’ fundi could be observed, aiding diagnosis. Five patients had combined viral encephalitis (33.3%), and one patient had been diagnosed with neonatal HSV meningoencephalitis after birth and had developed ARN when she was 9 years old. Seven patients had retinal detachment complications (46.7%). Eleven patients were immunocompetent, except for one patient whose information was not available; thus, her immune status could not be determined. Moreover, three patients were immunocompromised due to prematurity. Seven patients had a clear history of neonatal HSV-2 infection, Six patients’ mothers had a history of HSV-2 infection, and 10 patients had other herpes virus infection-like manifestations prior to ARN.

HSV-2 ARN is similar to ARN, due to viruses such as HSV-1 and VZV, in terms of clinical manifestations, treatment, and prognosis in children. However, these two conditions also differ slightly. HSV ARN is mostly associated with viral encephalitis compared with VZV ARN (11, 24) (Table 1). However, after a review of the case summaries, our findings indicated that 11 of 15 patients with HSV-2 ARN were immunocompetent (Table 1), which corroborated the reported claim that patients with HSV ARN are usually immunocompetent (6). However, some studies have shown that patients with VZV, CMV, and EBV ARN may be in an immunosuppressed state in association with diseases such as human immunodeficiency virus infection, congenital heart disease, and leukemia (25, 26).

ARN can be due to direct viral infection or reactivation of a latent virus, or can occur secondary to diseases such as viral encephalitis, varicella, and herpetic keratitis (27). HSV-2 is mainly transmitted sexually. Direct infection in childhood is relatively rare, and neonatal infection often results from vertical maternal transmission. In this case, the child had no history
| References                  | Age | Sex | Affected eye | Initial visual acuity | Whether the fundus could be seen in the early stage | Immune status | Neonatal herpes infection | Other systemic illnesses | Whether it was complicated with meningitis or encephalitis | Treatment | Complications | Prognosis |
|----------------------------|-----|-----|--------------|-----------------------|--------------------------------------------------|---------------|----------------------------|--------------------------|-----------------------------------------------------------|------------|---------------|-----------|
| Tan et al. (14)            | 9 yr| F   | Right        | 20/60                 | YES                                              | Immunocompetent | N/A                        | Annual recurrences of right earlobe blistering since 5 | NO                      | Systemic antiviral | NO        | 20/40         |
| Tan et al. (14)            | 10 yr| M   | Left         | 20/30                 | YES                                              | Immunocompetent | N/A                        | Cold sores              | HSV encephalitis                                          | Systemic antiviral | RD           | CF        |
| Tran et al. (15)           | 11 yr| M   | Left         | OD                    | YES                                              | Immunocompetent | N/A                        | Oral herpes at 3 months, RD (OD) at 9, extracapsular cataract extraction | NO                      | Systemic and topical antiviral and steroid         | NO        | 20/40         |
| Landry et al. (16)         | 9 yr| F   | Left         | HM (OS)               | NO                                               | Immunocompetent | YES*                       | Neonatal HSV meningoencephalitis | NO                      | Systemic antiviral, topical steroid, vitrectomy with scleral buckle, laser | NO        | 20/60         |
| Khurana et al. (17)        | 14 yr| F   | Right        | CF (OD)               | YES                                              | Immunocompetent | N/A                        | Perinatal herpetic keratitis (OS) | NO                      | Systemic antiviral and steroid, laser                  | RD        | 20/50         |
| Khurana et al. (17)        | 10 yr| F   | Left         | 20/40                 | YES                                              | Immunocompetent | Yes                       | HSV-positive vesicular scalp dermatitis at 8-day-old | NO                      | Systemic and topical antiviral                         | RD        | 20/200        |
| Charles (10)               | 8 yr | F   | Right        | N/A                   | YES                                              | N/A            | Maybe                      | Developmental delay            | NO                      | Systemic antiviral and systemic steroid, systemic steroid | NO        | N/A           |
| King et al. (18)           | 9 yr | F   | Left         | 20/200                | YES                                              | Immunocompetent | Maybe*                     | Axial muscular hypotony at 2 months, chickenpox at 3, a right non-granulomatous panuveitis at 5 months | NO                      | Systemic antiviral and steroid and cycloplegic         | RD        | N/A           |
| Chiquet et al. (19)        | 4 yr | M   | Right        | 20/200                | YES                                              | Immunocompetent | Maybe                     | Axial muscular hypotony at 2 months, chickenpox at 3, a right non-granulomatous panuveitis at 5 months | NO                      | Systemic antiviral and steroid and cycloplegic         | RD        | N/A           |
| Tanaka-Kitajima et al. (20) | 3 yr | M   | Left         | 20/50                 | YES                                              | Immunocompetent | Maybe*                     | Periocular trauma           | NO                      | Systemic antiviral and steroid                          | NO        | 20/20         |
| Gupta et al. (21)          | 25 days| M   | Both         | N/A                   | YES                                              | Immunocompromised | YES*                       | Premature, twin birth, twin brother died, crusted skin eruptions with ulceration | HSV encephalitis | Systemic antiviral, laser                              | RD(OS)   | N/A           |

(Continued)
of HSV-2 infection. For children without a known history of neonatal HSV-2, the pathogenesis of HSV-2 ARN has not been clarified. The generally accepted mechanism is that newborns are infected with HSV-2 at delivery through the birth canal in parturients with genital herpes. The virus may enter the body through sensory nerves located in the conjunctiva or nasal epithelium and travel in neural tissues, such as the olfactory and trigeminal nerves (10). The virus lies latent in newborns but does not cause symptoms of infection, and newborns remain in a state of subclinical HSV-2 infection. At some future point, latent infection can escalate to overt infection due to certain triggers, such as periocular trauma (20), neurosurgery, high-dose corticosteroids, and immunosuppressive agents (24). The virus reactivates and travels to the eye, causing ARN.

Viral encephalitis can be caused due to the reactivation of HSV-2 in the brain or through a retrograde passage of the virus activated in the eye to the brain (28). ARN has been found to be associated with viral encephalitis in several studies. According to previous literature, approximately 13.5% of patients with ARN have combined viral encephalitis, of which 57.1% involves herpes simplex encephalitis (29). Moreover, this proportion also appears to be high among children. Of 15 pediatric patients with HSV-2 ARN, five (33.3%) were found to have viral encephalitis after a retrospective analysis of the relevant cases (14, 21, 23) (Table 1). This may be related to the fact that children have lower immunity than adults, and that they cannot accurately describe the symptoms in time, thus increasing the incidence of complications. Therefore, ophthalmologists should be aware of whether patients have central nervous system infections especially when diagnosing and treating children with ARN.

ARN syndrome generally has a poor prognosis (9) and can quickly affect the other eye if left untreated (30). Early diagnosis and therapy are key to maintaining vision and preventing the involvement of the other eye (16). The diagnostic criteria for ARN include single or multiple retinal necrosis lesions (22). However, in this case, it had not been previously determined that our patient had severe vitreous opacity in the early stage as her fundus could not be observed, which posed a major challenge to our diagnosis. After a timely anterior chamber tap, the diagnosis was confirmed. We consider that the cause of severe vitreous opacification in this patient was possibly due to her normo-immune system. After the virus is activated in the eye, the immune system begins to function. Immune cells engulf the virus (31) and activate other associated cells (32). They also produce cytokines and mediate inflammatory reactions (33), which cause severe intraocular inflammatory reactions and severe vitreous opacification. Therefore, for suspected cases with invisible fundus, early intraocular fluid examination is especially helpful for the differential diagnosis.

The basic treatment methods for ARN mainly include systemic antiviral, anti-inflammatory, and antithrombotic therapy, and local application of cycloplegic eye drops (8). Currently, there are no clear criteria for the treatment of ARN in children although treatment in children has been similar to that in adults. In this case, the child was mainly administered a systemic intravenous infusion and intravitreal injection of drugs in the left eye as part of antiviral therapy, and steroids as part of
anti-inflammatory therapy. Early and comprehensive treatment promptly inhibited further retinal damage, and prevented involvement of the other eye.

ARN complications have been found to mainly include retinal detachment, with a general detachment rate in patients with ARN of 49% (34). Retinal detachment was also observed in seven (46.7%) of the 15 pediatric cases of ARN due to HSV-2 in our study (14, 17–19, 21, 22), as shown in Table 1. Once retinal detachment occurs in children, it predisposes them to more serious consequences than those occurring in adults. There can be several reasons why children may present late to an eye clinic after a long period of retinal detachment. In such cases, at presentation, the lesions in these children are prone to involve the macula, accompanied with serious complications, such as proliferative vitreoretinopathy. Prophylactic laser treatment at the macula, accompanied with serious complications, such as proliferative vitreoretinopathy. Prophylactic laser treatment at the earliest possible time has been reported to significantly reduce the risk of retinal detachment in ARN (35, 36). However, it remains to be elucidated whether prophylactic laser treatment is fully effective in preventing retinal detachment (2). In our young patient, prophylactic laser treatment was performed in time to prevent retinal detachment when the child was followed up for 2 months, which enabled subsequent stabilization and recovery. However, the long-term effects of prophylactic laser treatment in preventing retinal detachment in this young patient require further follow-up.

In conclusion, we report a case of ARN with viral encephalitis in an immunocompetent child with HSV-2 infection. The pathogenesis of HSV-2 ARN in children may be due to the acquisition of subclinical infection with HSV-2 during parturition, followed by reactivation of the latent virus in the body due to certain factors. The unique feature of this case was that our patient had severe vitreous opacity in the early stage, making the fundus unobservable, which made diagnosis challenging. Early diagnosis was confirmed using a timely anterior chamber tap. Early administration of antiviral drugs for comprehensive treatment curbed the development of the disease, prevented involvement of her other eye, and achieved a good therapeutic effect. A subsequent prophylactic laser retinopexy may have helped prevent a retinal detachment in the affected eye. This outcome suggests that early diagnosis, early treatment, and subsequent prophylactic laser treatment may improve the prognosis of pediatric ARN. Moreover, in the process of diagnosis and treatment, it is particularly important to assess the presence of central nervous system infection. The low incidence of pediatric ARN increases the chances of this disease being missed during diagnosis and treatment by both pediatricians and ophthalmologists.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Second Hospital of Hebei Medical University. Written informed consent to participate in this study was provided by the participant’s parents. Written informed consent was obtained from the participant’s parents for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

LH consulted literature, curated the data, and drafted the manuscript. QS diagnosed, treated, and followed up our patient. JD diagnosed and treated our patient, proposed the idea for the case report, followed up our patient, collected photos, and reviewed the article. All authors contributed to the article and approved the submitted version.

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