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High-Altitude Retinopathy and Retinal Hemorrhage: A Case Report

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Abstract

This paper introduces a case of High-Altitude Retinopathy (HAR) with decreased vision and retinal hemorrhage after living at a high-altitude.

Retinopathy caused by high-altitude is described in this case. A 41-year-old healthy man started from an altitude of 143 feet (43.5 meters) and reached an altitude of 13,780 feet (4,200 meters) within one day. After 4 months of residence, he developed decreased vision accompanied by visual field defects in his left eye. Ophthalmic examination revealed bilateral papilledema, peripapillary hemorrhage in his left eye, and retinal hemorrhage in the macular area of optic papilla. He was diagnosed with HAR. After 3 months of treatment, the patient's symptoms and signs improved.

HAR can occur when the human body enters the high-altitude area (the altitude above 3,000 meters) from the low altitude area in a short period of time. This case has deepened the understanding of the effects of high-altitude environment on the retina, and suggested the importance of early diagnose and treatment.

Keywords: High-altitude retinopathy; Retinal hemorrhage; High-altitude sickness; Hypoxia

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Introduction

When the human body enters the high-altitude area (the altitude above 3,000 meters) from the low altitude area, a series of diseases caused by hypoxia are collectively called High-Altitude sickness (HAI). The clinical manifestations of high-altitude diseases include Acute Mountain Sickness (AMS), High-Altitude Retinopathy (HAR), High-Altitude Cerebral Edema (HACE) and High-Altitude Pulmonary Edema (HAPE). It has been shown that HAR is closely related to the occurrence and progression of HACE and HAPE [1].

The ocular symptoms of HAR are tortuous retinal veins, diffuse or punctate retinal hemorrhage (occasionally located in the macula), vitreous hemorrhage, papillary edema, congestion, peripapillary hemorrhage, etc. [2]. This paper describes a case of HAR in a 41-year-old healthy man who started from an altitude of 143 feet (43.5 meters) and reached an altitude of 13,780 feet (4,200 meters) within one day.

Case Presentation

In July 2022, the 41-year-old man set off from the area at an altitude of 143 feet (43.5 meters) and reached 13,780 feet (4,200 meters) above sea level in Yushu, Qinghai Province, within one day. Yushu City is located in the eastern part of the Qinghai-Tibet Plateau, which is the backbone of the terrain formed by the remaining veins of Tanggula Mountain, and has an average elevation of 4493.4 meters. It is a typical plateau and alpine climate. The oxygen content of the air is low, only 40% ~ 60% of what it is at sea level. The atmospheric pressure is about 60 kPa [3]. He resided there until November 2022 for 4 months, with about 4 h to 8 h of physical activity every day. He subsequently developed reduced vision and visual field defects in his left eye, with no systemic symptoms such as headache, dizziness, vomiting or other discomfort. Because his symptoms did not alleviate, he returned to the area of an elevation of 143 feet (43.5 meters) to visit the ophthalmology department.

During the presentation, it was noted that he had decreased visual acuity in his left eye and a sub-nasal visual field defect that had persisted for 2 weeks. The patient had no history of other ocular diseases, systemic diseases, trauma, or surgery. At the same time, he was not taking any oral medication. At the first visit, the corrected visual acuity was 1.0 (20/20) in the right eye and 0.7

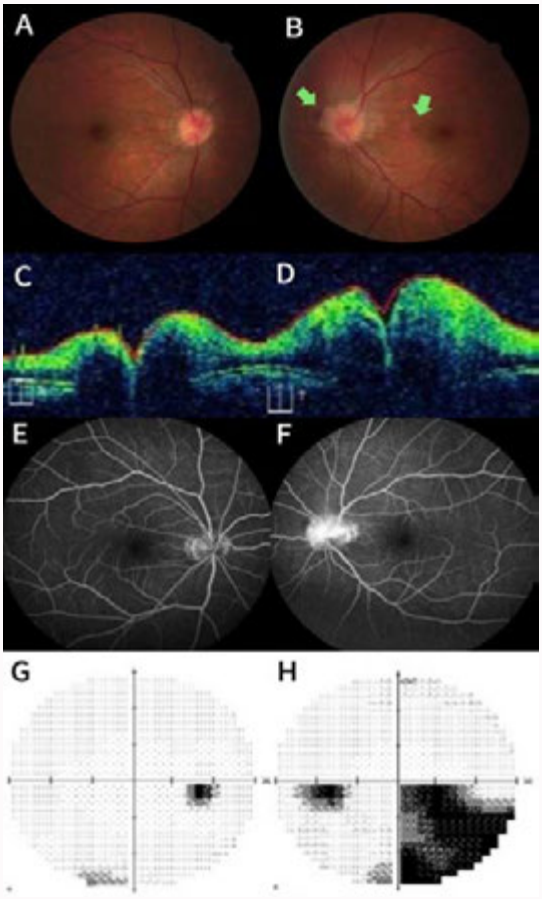

Figure 1: Color fundus photography showed indistinct and congested optic disc boundary, papilledema bulging, which is more severe on the left than on the right. The retinal veins were slightly tortuous and dilated, and the ratio of retinal artery to vein was about 1:2. As indicated by the arrow, lamellar superficial hemorrhage was seen on the nasal side around the optic disc in the left eye, and lamellar retinal hemorrhage was seen in the optic papilla macular area (A, B); OCT showed a W-shaped protuberance in the optic disc (C, D); FFA showed mild late-stage fluorescein leakage in the right optic disc and significant late-stage fluorescein leakage in the left optic disc. Blocked fluorescence was observed on the nasal side of the optic disc in the left eye, which was consistent with color fundus hemorrhage (E, F); Humphrey's visual field showed an inferior visual field scotoma in the right eye and an inferonasal visual field defect in the left eye(G, H).

(14/20) in the left eye. Intraocular pressure was 12 mmHg in both eyes. Slit-lamp biomicroscope showed no positive sign in the bilateral anterior segment of both eyes. Color fundus photographs showed indistinct and congested disc boundaries with papilledema bulges, which were more severe on the left than on the right. The retinal veins were slightly tortuous and dilated, and the ratio of retinal arteries to veins was about 1:2. Lamellar superficial hemorrhage was seen on the nasal side around the optic disc in the left eye, and lamellar retinal hemorrhage was seen in the optic papilla macular area (Figure 1A, 1B). OCT showed an increase in the thickness of the optic nerve fiber layer in both eyes and a W-shaped protuberance in the optic disc (Figure 1C, 1D). FFA showed mild late-stage fluorescein leakage in the right optic disc and significant late-stage fluorescein leakage in the left optic disc. Blocked fluorescence was observed on the nasal side of the optic disc in the left eye, which was consistent with color fundus hemorrhage (Figure 1E, 1F). Humphrey's visual field showed an inferior visual field scotoma in the right eye and an inferonasal visual field defect in the left eye (Figure 1G, 1H).

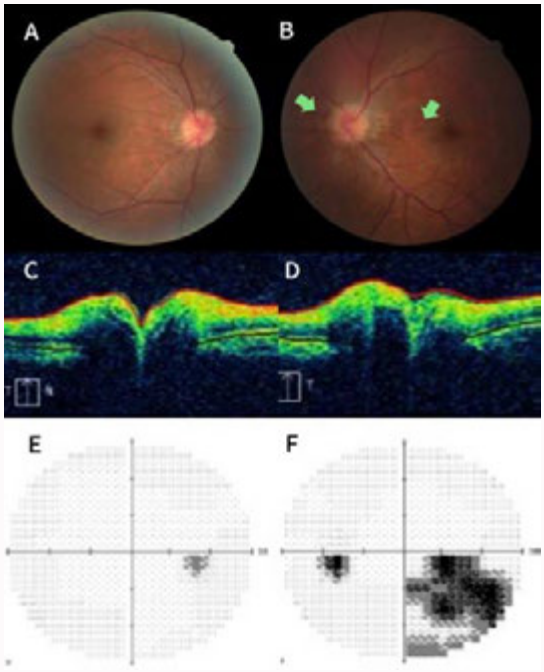

Figure 2: The second Color fundus photography revealed a reduction in papilledema binocular. As indicated by the arrow, there was also significant absorption of superficial hemorrhage in the macular area of optic papilla and on the nasal side of the optic disc in the left eye (A, B); OCT showed a reduction in papilledema (C, D); The second Humphrey visual field showed that the defect in the inferior nasal quadrant of the visual field in the left eye was smaller than that in the anterior (E, F).

At the same time, the patient underwent blood routine and biochemical tests. It was found that his hematocrit and hemoglobin content were elevated. This suggests an increase in blood viscosity, which, notably, is thought to be a contributing factor to HAR [4]. The patient was given a peribulbar injection of triamcinolone acetonide to the left eye for anti-inflammatory treatment, oral medication to improve microcirculation, oral mecobalamin tablets, and vitamin B1 nutritional nerve therapy.

Four months later, the patient returned to the ophthalmology clinic and reported a reduction in visual field defects in the left eye. The corrected visual acuity in both eyes was the same as in the initial presentation. Color fundus photography revealed reduced papilledema in both eyes. There was also significant absorption of superficial hemorrhage in the macular area of optic papilla and on the nasal side of the optic disc in the left eye (Figure 2A, 2B). OCT showed a reduction in papilledema (Figure 2C, 2D). Humphrey's visual field showed that the defect in the inferior nasal quadrant of the visual field in the left eye was smaller than that in the anterior (Figure 2E, 2F). ERG showed that cone function was impaired in both eyes, more so in the left eye than in the right (Figure 3).

Discussion

Previous reports have suggested that high-altitude and hypoxia as risk factors for HAR [5]. Hypoxia can lead to incomplete oxidation of the body's tissues, and the accumulated metabolites can have toxic effects on the tissues, thereby increasing vascular permeability and causing retinal edema, hemorrhage, and exudation [6]. Weidman and Tabin divided HAR into four different grades. Grade 1: Mild retinal hemorrhage of the retinal vein in one PD area; Grade 2: Moderately dilated retinal vein with retinal hemorrhage in two PD areas; Grade

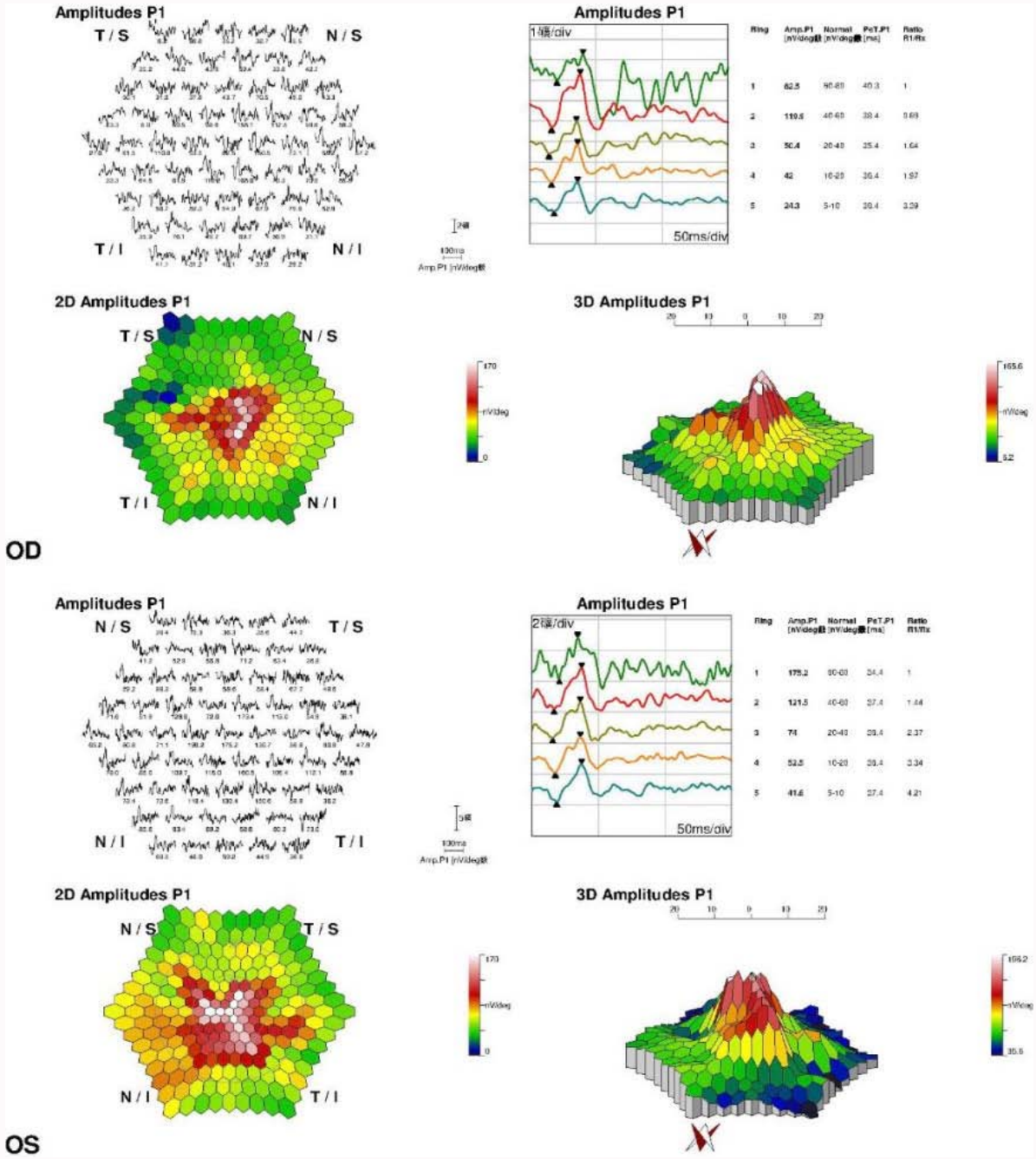

Figure 3: ERG showed impaired cone function in both eyes, with the left eye more damaged than the right.

3: Significantly dilated retinal vein with retinal hemorrhage in three PD areas, as well as perimacular retinal hemorrhage and vitreous hemorrhage; Grade 4: The retinal vein is significantly dilated and bluish-purple, the retinal hemorrhage is larger than in 3 PD areas, and the macula and retinal vein are tortuous and dilated, affecting central visual acuity [7]. Meanwhile, high-altitude climbers often have elevated hematocrit and hemoglobin concentrations, which can lead to increased blood viscosity, increased clotting, and reduced oxygen delivery [8]. In the first report on HAR published in 1968, Singhet et al. [9] observed papilledema, retinal vein dilatation and retinal hemorrhage in a patient who rose to high-altitude within a short period of time. In addition, Frayser et al. [10] found that 9 out of 25 subjects (36%) had retinal hemorrhage at an altitude of 17,500 feet (5,334 meters). These are the earliest documented cases of HAR. Subsequent reports of related cases are rare.

Interestingly, Arora et al. [8] found that HAR is more common in young, well-trained people at high altitudes. This may be due to the dilation of blood vessels and the increase of systemic circulatory pressure to which the retina is more susceptible in young adults during exercise. This case is also a case of ocular disease in young and middle-aged people under continuous high-intensity physical activity, which may support the above statement. The study by Xi Tian et al. [3] showed that three months after subjects returned to baseline altitude, their retinal condition could return to a normal state, indicating that an increase in atmospheric oxygen content and a decrease in altitude can restore nerve and vascular function. This

could also provide evidence that the disease generally has a better prognosis. The occurrence and development of high-altitude sickness depends not only on the rising height, but also on the rising speed, adaptation to high-altitude, personal baseline level and other possible genetic and environmental factors [11]. Because the human body moves rapidly from low to high altitudes in a short period of time, it is difficult for the body to immediately adapt to the high altitude and hypoxia environment, and is therefore prone to HAI. The most important thing for HAR is prevention, with a particular focus on slow ascent rates and adequate adaptation time. Once symptoms of HAI appear, stopping further ascent and starting oxygen supplementation and slow altitude reduction are recommended as the best treatment options [1]. Other related literature reports [11], if the human body can gradually tolerate high-altitude and low oxygen content during the slow adaptation process. Therefore, a climber who is already well adapted to such conditions can climb the Himalayas, reach (and descend from) the summit without using additional oxygen. This suggests that slowing the ascent rate and gradually adapting to lower oxygen levels is beneficial for HAI prevention. Moreover, Wiedman and Tabin [7] observed 40 climbers with an altitude of more than 4,870 meters and found that all those with HACE had HAR. They argued that treatment of HACE with oxygen, steroids or diuretics should be initiated as soon as possible following a diagnosis of HAR, and that altitude reduction should be initiated immediately to prevent further development of HACE. Another study also confirmed that the severity of HAR was significantly associated with diseases such as HAPE and HACE [8]. All the above studies demonstrate the importance of early diagnosis of HAR to prevent the development of life-threatening HACE. With the development of science and improved examination methods, early HAR can be identified and diagnosed with modern advanced instruments. In addition to the conventional diagnostic methods, it is worth mentioning that ERG can detect the impaired function of cone cells in early HAR and it can be seen that ERG was used for early diagnosis of HAR in this patient.

Conclusion

In conclusion, this case of early HAR makes us pay more attention to the early clinical symptoms and signs of HAR. Early diagnosis and treatment, prevention and further prevention of HACE and HAPE may create a better prognosis for patients.

More importantly, timely detection and diagnosis of acute altitude illness can alert physicians to the possibility of the presence or occurrence of other more lethal conditions, such as HAPE and HACE.

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Data collection was done by FR and WYN. Literature search was done by FR. FR and WYN interpreted data. WYN and LDC drafted the word. WYN and LDC Revised the Work. All authors read and approved the final manuscript.

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