



Cerebrospinal fluid hypovolemia syndrome after a traffic accident with abnormal eye movements: A case report

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ABSTRACT

Purpose: To describe a rare case of cerebrospinal fluid hypovolemia syndrome after a traffic accident with abnormal eye movements.

Observations: A 19-year-old man was referred to our clinic after being hit by a car five months ago while riding a bicycle. After the accident, he sometimes noticed oscillopsia, and had postural headaches and reading difficulties. His eye movement recording revealed square wave jerks during fixation and decreased pursuit gain during horizontal smooth pursuit. MR myelography detected cerebrospinal fluid leakage and the patient was diagnosed with cerebrospinal fluid hypovolemia. After undergoing epidural blood patch therapy, the leakage disappeared, and his postural headaches improved immediately. Square wave jerks and decreased pursuit gain improved, and his oscillopsia and reading difficulty also improved after therapy.

Conclusions and importance: A patient with cerebrospinal fluid hypovolemia presented with square wave jerks and decreased pursuit gain. Epidural blood patch therapy was effective for the symptoms. When treating patients with oscillopsia and postural headaches, we should consider the possibility of cerebrospinal fluid hypovolemia syndrome in the differential diagnosis.

1. Introduction

Cerebrospinal fluid hypovolemia syndrome (CHS) is rare clinical entity that can be caused by spontaneous cerebrospinal fluid (CSF) leakage.^{1–3} The symptoms may be preceded by trauma, and patients often present with postural headaches as the main symptom and/or nausea, vomiting, and occasionally ocular manifestations, including blurred vision, photophobia, double vision, visual field defects and nystagmus.^{4,5} However, the mechanisms underlying these ocular manifestations are not well understood. To our knowledge, there was no report that specifically considered the mechanism of nystagmus. This is the first case report to describe the abnormal eye movements associated with CHS in detail using infrared eye movement monitoring.

2. Case report

A 19-year-old man was referred to our clinic because of impaired smooth pursuit eye movements. He had been hit by a car five months ago while riding a bicycle. Brain MRI found no abnormalities. After the traffic accident, his mother noted his abnormal eye movements and he sometimes noticed oscillopsia. He had postural headaches and reading difficulties. His past medical history and his family history were unremarkable.

On examination at the first visit, his best-corrected decimal visual acuity was 1.2 in both eyes. There was no limitation in extraocular muscle movement in either eye. Slit lamp and fundus examinations yielded normal findings in both eyes. Blood test results were unremarkable. No abnormalities were found on brain and orbital MRI.

Eye movement was detected using an infrared eye movement

Abbreviations: Cerebrospinal fluid hypovolemia syndrome, (CHS); cerebrospinal fluid, (CSF); magnetic resonance imaging, (MRI); MR myelography, (MRM); epidural blood patch, (EBP); and square wave jerks, (SWJs).

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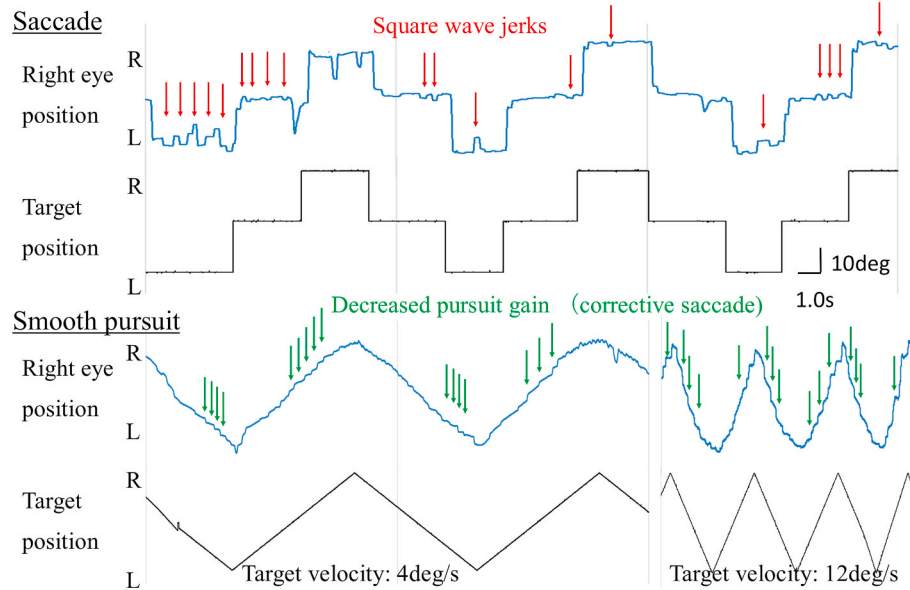
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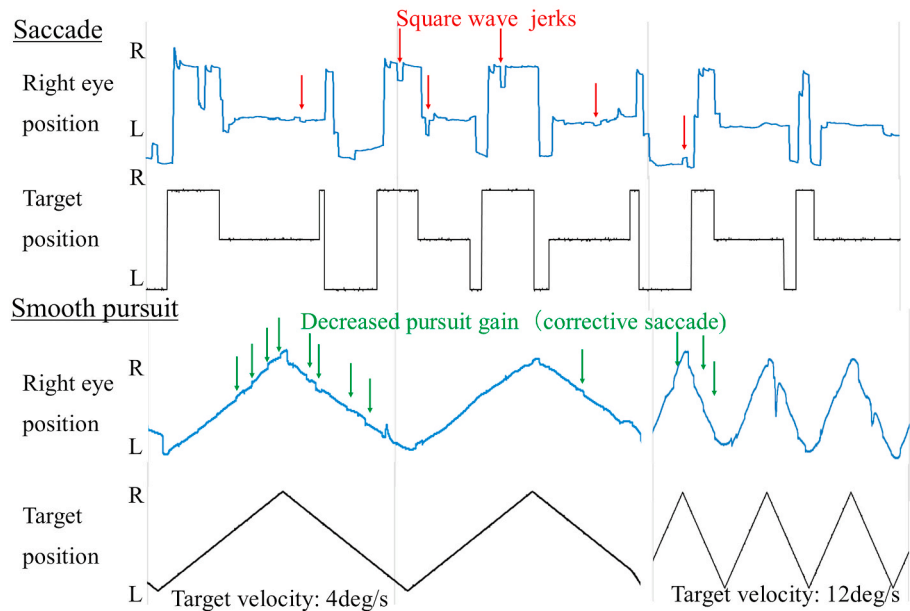
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A. Infrared eye movement recording at first visit



B. Infrared eye movement recording after EBP



monitor (Takei Scientific Instruments Co., Ltd. Niigata, Japan). A visual target was controlled by an oculomotion stimulator (Hamamatsu Photonics K.K., Hamamatsu, Japan) and projected on a screen 100 cm in front of the patient. Both signals were digitized at 500 Hz, transferred to a PC, and processed in the LabVIEW environment (National Instruments, Austin, USA). The visual target stepped 20° horizontally from the center in the saccade task and moved horizontally at a constant speed for a total of 40° in the pursuit task. The results are shown in Fig. 1. His eye movements were recorded at the first visit (Fig. 1A). Square wave jerks (SWJs) were frequently observed during center fixation and when staring right or left during the saccade task (Fig. 1A, upper). Staircase patterns of saccadic pursuit, suggesting decreased pursuit gain, were noted during pursuit tasks (target velocities: 4 deg/sec and 12 deg/sec), as shown in the bottom of Fig. 1A. On the other hand, saccade gains were in the normal range (rightward: 0.96 ± 0.15 , leftward: 1.09 ± 0.14 , Fig. 1A, upper).

MR myelography (MRM) was performed and the patient was diagnosed with CHS. MRM was obtained on a 1.5-T MR unit (Achieva 1.5T A-series, PHILIPPS, Cleveland, USA) using a phase-array spinal coil, which demonstrated hyper-intensities along the extradural portion of the filum terminale, as shown in Fig. 2A. He underwent epidural blood patch (EBP) therapy four months after the first visit, and his postural headaches improved immediately. His oscillopsia and reading difficulty also improved gradually, and a re-examination of his eye movements was performed three months after EBP (Fig. 1B).

The frequency of SWJs decreased (Fig. 1B, upper) pursuit gain increased at each velocity after EBP (Fig. 1B, bottom). The pursuit gain rightward increased from 0.57 ± 0.27 to 0.98 ± 0.15 and that leftward increased from 0.48 ± 0.09 to 0.96 ± 0.16 when the target velocity was 4 deg/sec (Fig. 1A and B, bottom-left). When the target velocity was 12 deg/sec, the pursuit gain rightward increased from 0.43 ± 0.14 to 0.83 ± 0.09 and that leftward increased from 0.54 ± 0.07 to 0.84 ± 0.19

Fig. 1. Infrared eye movement recording at the first visit (A) and after EBP (B). Horizontal saccade and smooth pursuit were recorded. Square wave jerks were observed during fixation in the saccade task (red arrows) and the staircase pattern in smooth pursuit task (green arrows) was noted, which reflected decreased pursuit gain(A). These abnormal eye movements improved after EBP(B). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

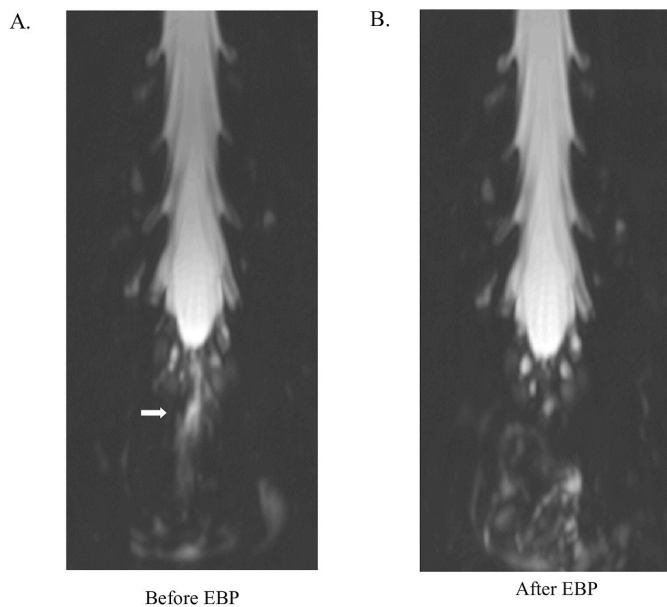


Fig. 2. MR myelography before and after EBP therapy. High-intensity signals were noted along the extradural portion of the filum terminale, indicating CSF leakage (A: white arrow) before EBP therapy, but they disappeared after EBP therapy (B).

(Fig. 1A and B, bottom-right). On MRM after EBP therapy, the hyperintensities disappeared, as shown in Fig. 2B.

3. Discussion

After EBP therapy, the patient no longer noticed oscillopsia or reading difficulties. Eye movement recording also revealed improvement of SWJs and staircase pattern during smooth pursuit. His oscillopsia and reading difficulties may have been caused by these abnormal eye movements associated with CHS.

SWJs are saccadic eye movements that are considered to be a pathological sign caused by fixation instability pointing to a central neurological lesion.⁶ Multiple sources have been suggested as generators for SWJs, including the cerebral hemisphere,⁷ the cerebellum,⁸ and superior colliculus.⁹ His oscillopsia may have resulted from fixation instability. Fixation abnormalities are also well-recognized in neurodegenerative disorders as Parkinsonian conditions, Alzheimer's disease and Multiple sclerosis.^{10–12}

When smooth pursuit gain decreases abnormally, the eye movement exhibits the "staircase pattern" because of the corrective saccades (compensatory catch-up saccades) during visual target tracking.¹³ Such smooth pursuit impairment is considered a sensitive sign of cerebral, cerebellar, or brainstem disease.¹⁴ As smooth pursuit eye movements also play an important role in reading,¹⁵ the impairment of pursuit can make it difficult to follow letters.

Simultaneous complication of these two abnormal eye movements has been reported in patients with spinocerebellar degeneration^{16,17} and Chiari malformations.^{18–20} CHS is often misdiagnosed as Chiari malformations because cerebellar tonsil descensus and syringomyelia in the spinal cord are observed in patients with either disease.^{21,22} MRI did not detect such lesions in our patient, but in the upright position, a decrease in cerebrospinal fluid may have compressed the lower cerebellum, as in Chiari malformation patients.

EBP therapy for CHS²³ may have improved these conditions by stopping cerebrospinal fluid leakage. MRM was useful for identifying CSF leakage and confirming the EBP effectiveness, as in previous reports.²⁴

4. Conclusions and importance

We reported a case of CHS after a traffic accident with square wave of jerks and decreased pursuit gain. EBP therapy was effective for the ocular symptoms and postural headaches. When treating patients with oscillopsia, difficulty reading, and postural headaches, we should consider the possibility of CHS in the differential diagnosis.

Patient consent

We received written consent from the patient to publish this report.

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Authorship

All authors attest that they met the current ICMJE criteria for Authorship.

Declaration of competing interest

Nil.

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