Graefes Arch Clin Exp Ophthalmol (2008) 246:1059–1060
DOI 10.1007/s00417-008-0780-0

CASE REPORT

Ophthalmodynamometric measurement of central retinal vein pressure as surrogate of intracranial pressure in idiopathic intracranial hypertension

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Received: 4 December 2007 / Revised: 19 January 2008 / Accepted: 24 January 2008 / Published online: 15 February 2008

Abstract
Background Since a direct non-invasive measurement of the cerebrospinal fluid pressure is not available, it was the purpose of the study to describe the non-invasive determination of the central retinal vein pressure as an estimate of an elevated cerebrospinal fluid pressure.
Methods A 28-year-old female patient with blurred vision, nuchal pain and prominent optic discs underwent modified ophthalmodynamometry to determine the central retinal vein pressure as surrogate of the intracranial pressure. A Goldmann contact lens with a pressure sensor mounted into its holding ring was placed onto the cornea. Pressure was applied to the globe by slightly pressing the contact lens until the central retinal vein started to pulsate/collapse.
Results Despite an abnormally high central retinal vein pressure (OD: 17 arbitrary units; OS: 33 arbitrary units), the neurological examination including magnetic resonance imaging of the brain was unremarkable on the first day. A lumbar puncture revealed a cerebrospinal fluid pressure of 25 cm H_2O, which was at the upper limit of the normal range. Over the next 2 days, ophthalmodynamometry showed increasing measurements of the central retinal vein pressure for both eyes, parallel to elevated cerebrospinal fluid pressure measurements by lumbar puncture, leading to the diagnosis of idiopathic intracranial hypertension. After treatment, the cerebrospinal fluid pressure returned to normal levels, parallel to a decrease in the central retinal vein pressure as determined by ophthalmodynamometry.
Conclusions Ophthalmodynamometry of the central retinal vein was helpful in the diagnosis of an elevated intracranial pressure, with direct lumbar pressure measurement running parallel to the ophthalmodynamometric measurements.

Keywords Ophthalmodynamometry · Cerebrospinal fluid pressure · Optic disc · Pseudotumor cerebri · Intracranial pressure (ICP) · Central retinal vein pressure · Venous outflow pressure

Introduction

Measurement of the cerebrospinal fluid pressure usually requires a lumbar puncture or craniotomy to get direct access to the cerebrospinal fluid space. These techniques are invasive, and carry the risk of complications such as infections and damage to the neural structures. Since it is, therefore, desirable to have a non-invasive method to estimate the intracranial pressure, and based on a previous report about the use of a modified type of ophthalmodynamometry for assessment of the intracranial pressure [1, 2], it was the purpose of the present report to describe a patient in whom non-invasive determination of the central retinal vein pressure allowed an estimation of an elevated cerebrospinal fluid pressure.

Proprietary interest: none.

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Methods

A 28-year-old female patient presented with blurred vision in her left eye and some nuchal pain. Visual acuity was 20/20 in both eyes, and visual fields were unremarkable, except for an enlarged blind spot. Both optic discs showed a prominence of 0.40 mm as measured by confocal laser scanning tomography. In the right optic disc, a small optic cup was detectable, while in the left eye with a smaller optic nerve head, no cupping was detected. Both optic discs showed an engorgement of the retinal veins, few hemorrhages and some cotton-wool spots. Intraocular pressure measured 15 mm Hg OU. With topical anesthesia, a Goldmann contact lens with a pressure sensor mounted into its holding ring was put onto the cornea as described in detail recently [3]. Pressure was applied to the globe by slightly pressing the contact lens. The pressure value at the time when the central retinal vein started to pulsate or collapse was noted.

Results

The central retinal vein pressure as assessed in arbitrary units by the ophthalmodynamometer was 17 units (OD) and 33 units (OS). It is in contrast to normal eyes, in which a spontaneous pulsation of the central retinal vein can be seen in about 80% to 90% of the cases [4, 5]. A neurological examination including magnetic resonance imaging of the brain was unremarkable. A lumbar puncture revealed a cerebrospinal fluid pressure of 25 cm H_2O, which was at the upper limit of the normal range.

At days 1 and 2 from initial examination, ophthalmodynamometric measurements of 25 arbitrary units and 30 arbitrary units for the right eye, and of 35 arbitrary units and 41 arbitrary units for the left right eye were recorded. A lumbar puncture now revealed elevated cerebrospinal fluid pressure measurements of 45 cm H_2O and 46 cm H_2O, and the diagnosis of an idiopathic intracranial hypertension was made [6]. Under the systemic therapy of acetazolamide (1 g/die) and repeated lumbar puncture of cerebrospinal fluid, the cerebrospinal fluid pressure was reduced to 15 cm H_2O during the following 2 days, and the ophthalmodynamometric values of the central retinal vein pressure decreased to 10 arbitrary units (OD) and 18 arbitrary units (OS). At 4 weeks after the event, both central retinal veins showed a spontaneous pulsation.

Discussion

The central retinal vein is of special interest because of two facts: (1) The intravasal pressure of the central retinal vein is modulated by the intracranial pressure, and (2) the venous pressure is accessible to measurements. After leaving the eye through the optic disc, the central retinal vein passes through the retrobulbar part of the optic nerve before it traverses through the subarachnoidal and subdural spaces of the optic nerve and pierces through the optic nerve meninges. The pressure in the central retinal vein is thus at least as high as the cerebrospinal fluid pressure [5, 6]. In addition, it has to be taken into account that under normal circumstances there may be a pressure drop between the venous ophthalmodynamometry value and the cerebrospinal fluid pressure, which is known to be approximately 8 mm Hg from experimental studies in dogs and monkeys [7, 8]. Concurring with that assumption and confirming a previous report [9, 10], the results of the present report suggest that the non-invasive measurement of the central retinal vein pressure by a modified ophthalmodynamometry allowed the estimation of an elevated intracranial pressure. The difference in the retinal vein pressure measurements, which were higher in the left eye than in the right eye, may have been due to the smaller optic disc in the left eye. In agreement with previous reports, the present study suggests that ophthalmodynamometry may be helpful in the diagnosis and monitoring of neurological diseases associated with an elevated brain pressure.

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