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Case Report

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Demonstration of optic nerve sheath fenestration success by ultrasound nerve sheath diameter assessment: A case report

Abstract

The aim of this study is to demonstrate the correlation between the decrease of the Ophthalmic Nerve Sheath Diameter (ONSD) assessed by Ultrasound after a Surgery of Optic Nerve Sheath Fenestration (ONSF) for the treatment of a Idiopathic Intracranial Hypertension (IIH) and its success in the perioperative period. A 21 year-old female diagnosed with IIH was scheduled for unilateral ONSF surgery. We evaluated the ONSD after and before the surgery. The measurements were: 71,5mm mean for the both eyes BEFORE the surgery (71,5mm for the LE and 71,5mm for the RE respectively) and 57,25mm, fifteen minutes AFTER the fenestration of the LE Optic Nerve Sheath (RE: 70mm LE: 44,5mm means). There was a difference in the Optic sheath in the Operated Left Eye (ONSD 54-35 mm) and we could estimate the location of the fenestration in the images. We think this is the ideal method to evaluate the response to the surgical treatment for the IIH patients as non-invasive, low cost and in-site technique.

Volume 8 Issue 3 - 2017

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Received: May 23, 2017 | **Published:** August 03, 2017

Introduction

Papilledema refers to optic disc swelling resulting from high intracranial pressure.[1] An important cause of papilledema and visual loss is Idiopathic Intracranial Hypertension (IIH), also known as pseudotumor cerebri, a condition in which the intracranial pressure is elevated with no obvious cause.[2] A primary goal of treatment in IIH is to prevent disabling visual loss. Visual loss is one of the major morbidities, with blindness reported in up to 10% of patients and visual field defects of some type in up to 90% of patients.[1,2] Optic nerve sheath fenestration (ONSF) is an effective treatment in patients with IIH who have progressive visual loss from chronic papilledema. Although prior reports have shown reduction of papilledema in both operated and unoperated eyes.[3-5]

The subarachnoid spaces surrounding the optic nerve communicate with the intracranial cavity and changes in cerebrospinal fluid (CSF) pressure are transmitted along the optic nerve sheath. In the anterior part of the optic nerve and particularly in the retrobulbar segment, the nerve is only surrounded by orbital fat. The retrobulbar optic nerve sheath is therefore distensible and can inflate in case of raised cerebrospinal fluid pressure. Comparing ocular ultrasonography with gold standard measures of ICP (invasive devices). It has been demonstrated that changes in cerebrospinal fluid (CSF) pressure cause changes in optic nerve sheath diameter (ONSD). Several studies have reported on the sensitivity and specificity of neuroimaging signs in patients with papilledema for IIH.[5,6] Unlike the other structures of the central nervous system, the optic nerve and its sheath can be visualized by imaging means as MRI or ultrasonography.

The Optic nerve sheath ultrasound is a noninvasive method for the assessment of the risk of raised ICP. values of ONSD above 5.8 mm have been shown to be associated with a 95% risk of raised ICP (*i.e.*, more than 20 mmHg).[7] Primary research by Hansen and Helmke showed a correlation between rising cerebrospinal fluid (CSF) pressure and ONSD.[8] Compared to invasive monitoring of ICP, more studies have identified a cutoff between 4.8mm and 5.9mm for ONSD correlation with EICP. Moretti et al.[9,10] compared ultrasound measurement of the ONSD to invasive ICP monitoring and found an ONSD cutoff of 5.2mm at the same time another author have a cutoff value of 4.8mm[11] specific for EICP. Even though no general consensus exists on the clinical applications of the ultrasonographic measurement of the ONSD, this has been proposed as a promising method to detect an increase of CSF pressure.[12] However, no studies have examined the use of Ultrasound imagining in the perioperative period before and after an ONSF procedure.[13]

Case presentation

A 21 year old female patient that has Idiopathic Intracranial Hypertension (IIH), Obesity and has been treated with Acetazolamine and Topiramato without correct response to her symptoms was referred to our for a surgical treatment from a peripheral institution by the Plastic Ophthalmic Department at the Hospital de Clinicas of Buenos Aires.

She had at ophthalmic exam:

A. **Right Eye (RE)**: increase of a Macular Central Spot.

B. **Left Eye (LE)**: longitudinal temporal and nasal Hemianopsia. Ocular Fundus Exam: not Retinal detachment, blurred edges. Ocular CT: not observed Papilledema. Another data: Overweight (BMI >25), repeated headaches without control.

Having agreed consent for use of data and images we made an assessment of ONSD after the induction of the general anaesthesia for the surgery. Measurements were made applied the probe over the closed upper eyelid. A 10-MHz linear probe (Turbo, Sonosite, Bothell, WA) was placed with ultrasound gel over the eyelid. The two-dimensional mode was used and ONSD was measured 3mm posterior the outermost layer of the retina using the calliper of the machine and an axis perpendicular to the Nerve.

For both optic nerves, two measurements were made, one in the horizontal plane and other in the perpendicular plane. The average of the two values corresponds as ONSD for each eye. For the Right Eye (RE) the measurement was 73-70mm (71,5mm average) and for

the Left Eye (LE) was 75-68mm (71,5mm average). The global mean before surgery was 71,5mm.

Fifteen minutes after the surgical closing of the eyelid we repeated the assessment of the ONSD and we tried to see the location of the cut in the Optic Nerve Sheath for the eye chosen by the surgeons (Figure 1 & 2). The new measurements were: RE: 70-70 mm and for the LE (the eye chosen for the fenestration): 54-35 mm. The global mean after the surgery was 57,25mm. A decrease in the sheath around the ON could demonstrate the place where the cut was made at the Nerve Sheath (Figure 2).

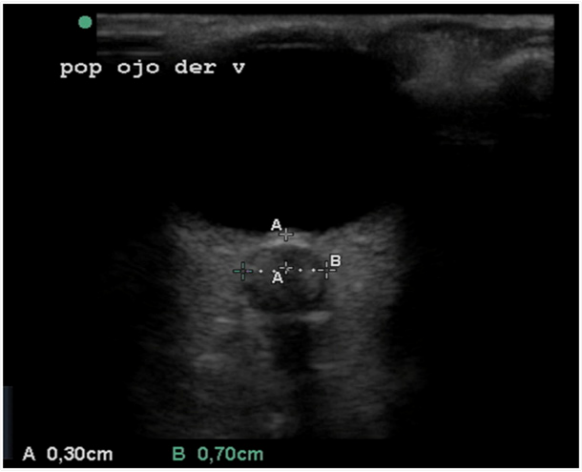

Figure 1 Right Eye 15 minutes after Surgery. ONSD 70mm.

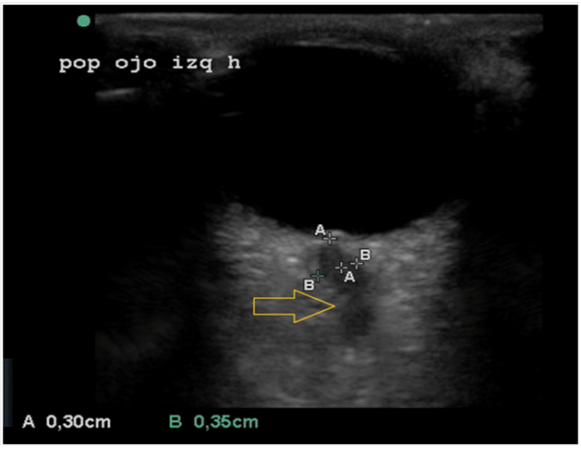

Figure 2 US IMAGE of the Left Eye Post Surgery: ONSD 35mm. Yellow Arrow: Site of the fenestration.

Discussion

Optic nerve sheath fenestration provides an effective surgical treatment for patients in whom medical therapy fails. In our case, unilateral ONSF decreased the diameter of Nerve sheath in the ipsilateral (operated) eye almost immediately after the fenestration but not changes were seen in the contralateral (nonoperated) eye at the short time.[2] The reduction of grade of papilledema in operated eyes was greater than in nonoperated eyes, but nonoperated eyes also experienced significant reduction in the disc edema grade with the correct time.[1,2] Until this moment the mechanism for this bilateral surgical effect is not certain and could be related to decrease the CSF in both optic nerves sheath after unilateral ONSF, regression toward the mean.[6]

We were not able to show a reduction in the bilateral ONSD average, maybe for the short time between the surgery and the measurements. It was not possible to evaluate the patient again at the recovery room because the operated eye was covered for one day, and she returned to the previous Clinic to be followed by her physicians. A later new evaluation showed a remission in the symptoms and could demonstrate a reduction in of ONSD as figures in the literature.[2,4,6] It is known that the reduction of the bilateral papilledema occurs around the 3 at 6 months after the operation, prior in the operated eye than in the non-operated eye.

It is our thinking that ONSD measurements are the ideal method to value the response to the surgical treatment for the IIH patients as non-invasive, low cost and in-site technique. This is the first case reported in the literature of the use ultrasound assessment for an OSNF after and before the surgery. Further works are needed to confirm the usefulness of this bed-side monitoring technique at the peri-operative period in the patients with Idiopathic Intracranial Hypertension.

Acknowledgments

I gratefully acknowledge to the Department of Oculo-Plastic Surgery, Dra Romina Tula and Dr Daniel Weil for their kind support.

Conflicts of interest

The author do not have financial interest or any conflict of interest exists in this article.

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Citation: Vidal E. Demonstration of optic nerve sheath fenestration success by ultrasound nerve sheath diameter assessment: A case report. *J Anesth Crit Care Open Access*. 2017;8(3):265–267. DOI: 10.15406/jaccoa.2017.08.00309