

**Case Report**

What was Happening in the Brain of a 13-Year-Old with Cluster Seizures: Real-Ish-Time Assessment of Optic Nerve Sheath Diameter (ONSD)

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Citation: Sobieraj M, Lipinska E, Jozefowicz-Sowa A, Stawicka E (2022) What was Happening in the Brain of a 13-Year-Old with Cluster Seizures: Real-Ish-Time Assessment of Optic Nerve Sheath Diameter (ONSD). Ann Case Report. 7: 1072. DOI: 10.29011/2574-7754.101072

Received Date: 25 November 2022; **Accepted Date:** 30 November 2022; **Published Date:** 02 December 2022

Abstract

Optic nerve sheath diameter (ONSD) measurement with ultrasound is a widely recognized way of intracranial pressure (ICP) assessment, corresponding with invasive-acquired readings with similar accuracy as magnetic resonance imaging (MRI) scans. As for now, its usefulness has been proved mostly among adult trauma patient however, each condition suspected of intracranial hypertension (IH) ought to result in ONSD enlargement. Accumulation of epileptiform elements in electroencephalography reflects abnormal neuronal activity, which is a proven factor elevating intracranial pressure. Cluster seizures and status epilepticus is commonly treated not only with antiepileptic drugs (AED), but also with anti-oedematous medications, confirming IH to be relevant clinical issue in pediatric epileptology. We report a case of a 13-year-old female with drug resistant epilepsy (DRE) admitted to our Clinic with cluster seizures, with decreasing measurements of ONSD as treated successfully with phenytoin.

Keywords: B-scan; Cluster seizures; Epilepsy; ICP; Intracranial pressure; Ocular ultrasound; ONSD; Optic nerve sheath diameter

Introduction

The assessment of the optic nerve sheath diameter (ONSD) using ultrasound is a recognized method of non-invasive measurement of intracranial pressure (ICP). Both in the course of targeted studies of this parameter and comparative studies using magnetic resonance imaging (MRI), high sensitivity and specificity of this method have been demonstrated. The optic nerve is an extension of the central nervous system surrounded by a sheath made of the same meninges that surround the brain, thanks to which ONSD correlates with ICP. It is a non-invasive procedure

and incomparably more sensitive than the assessment of the optic disc during fundus examination, because the read measurements correspond to the current ICP values. While maintaining the appropriate standards (at least double measurement in the B-mode projection and measurement at a precisely defined point - 3 mm back from the wall of the bulb) eye) and safety procedures (reducing the mechanical index to 0.3, shortening the examination time to a minimum, no pressure on the eyeball), the examiner is able to precisely assess the change in intracranial pressure at the bedside, immediately after the occurrence of symptoms that may suggest an increase in ICP [1].

The problem of increased ICP during epileptiform activity, historically described by researchers since the beginning of the 20th century, was finally confirmed by the use of intracranial electrodes

for EEG. Currently, we know that during epileptiform activity in the EEG record and/or clinically occurring convulsions, the ICP measured by invasive methods increases. The greater the number of neurons showing epileptic activity, the higher the increase in ICP, which may lead to further intensification of epileptic activity in the mechanism of a vicious circle. However, there are no international standards defining the criteria for anti-oedematous treatment in patients with multiple seizures, whether clinical or only visible in the EEG or even in status epilepticus. Currently, this issue is resolved in an inaccurate manner, depending on the patient's clinical state physician's own experience and the center in which he works. The problem of the lack of recommendations for anti-oedematous treatment also applies to other symptoms or diseases of the central nervous system, such as headaches or neuroinfections [2].

Measurements of ONSD in pediatric patients in previous studies took place primarily in intensive care units, in patients after neurosurgical procedures or injuries, presented with clinical symptoms of intracranial hypertension correlated with invasive measurements. With the obvious impossibility of multiple ICP checks in children using invasive tests outside of intensive care units, the assessment of ONSD seems to be extremely useful. [3] Thanks to its use, anti-oedematous treatment can be individualized. Noteworthy is the proven steep learning curve of ONSD measurement, which may determine the wide availability of this test [4].

Case Report

A 13-year-old girl with drug resistant epilepsy of undetermined etiology was admitted to the Clinic for the first time, urgently, due to the intensification of seizures. Patient's family history remained with no relevant conditions. Gestation and peripartum period was uneventful. Psychomotor development was normal. Epileptic seizures firstly occurred in August 2013 (age 4 years and 11 months) - focal, tonic seizures with impaired consciousness – single and in clusters.

In EEG studies, in the frontal, temporal leads on the left side (in some studies bilateral, periodically generalizing) epileptiform

discharges were seen. The MRI of the brain (performed in August 2013, February 2018, January 2020, May 2022) showed no abnormalities. Previously to reported hospitalization she was treated with valproate, levetiracetam, oxcarbazepine, carbamazepine, lacosamide, clonazepam, topiramate, clonazepam, methylprednisolone. Patient remained seizure-free for the longest period from August 2013 to May 2015.

On admission, the girl was in serious general condition, drowsy, 13 PGCS, with no signs of infection, neurological examination was non-focal. Earlier that day and at the time of admission cluster seizures was constantly present: a right-sided tonic seizure with a stereotypical movement of the left upper limb, with flushing of the face, lasting about 30 seconds to one minute, at intervals of 5-30 min.

After analyzing the history, clinical picture and additional tests, it was decided to modify the antiepileptic treatment - phenytoin was introduced, initially in a saturating intravenous infusion, then per os. Plasma drug concentration level was assessed regularly due to unstable pharmacokinetics. Remission of epileptic seizures was achieved on the first day of treatment, together with normalization of EEG results. In the first stage of treatment, side effects of phenytoin were observed: axial ataxia and horizontal nystagmus. During hospitalization, a gradual improvement in functioning was observed, patient presented good intellectual potential.

The girl remained seizure-free until discharge from the hospital.

Method and Results

Four separate ONSD measurements were performed using ophthalmic ultrasound device ECHOSON PIROP – B-mode, 0, 23 mechanical index (MI), 3 mm posterior to the globe, in transverse axis - in left and right eye. 0, 9% NaCl was used as a singal improver rather than ultrasound gel for more comfortable examination.

First, one just before phenytoin infusion - right ONSD - 5, 9 mm (Figure 1), left ONSD - 5, 1 mm (Figure 2).

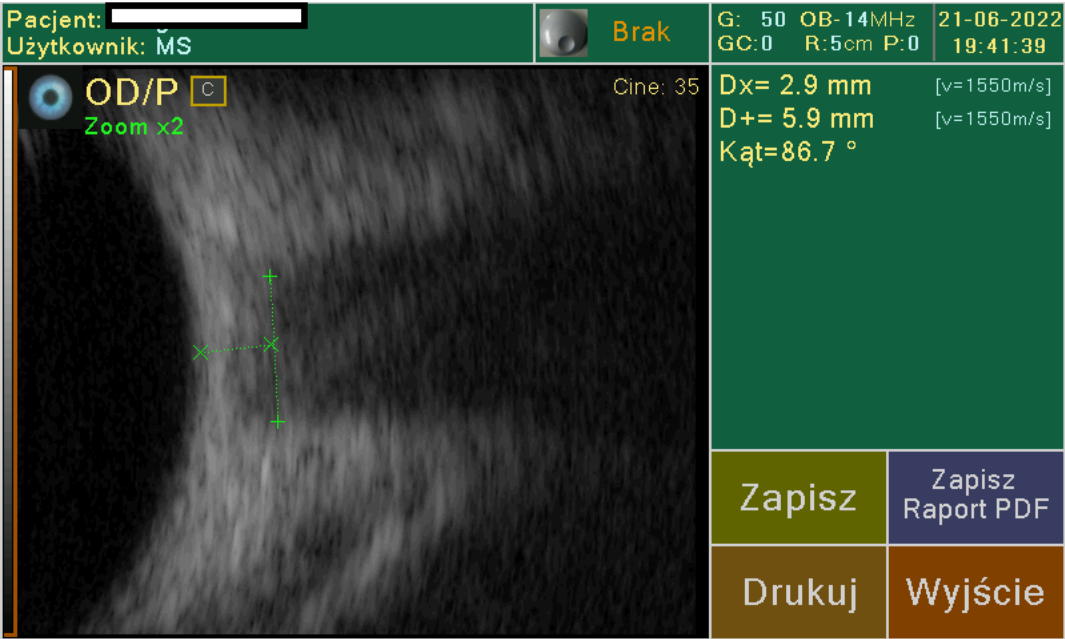


Figure 1: Right ONSD before treatment.

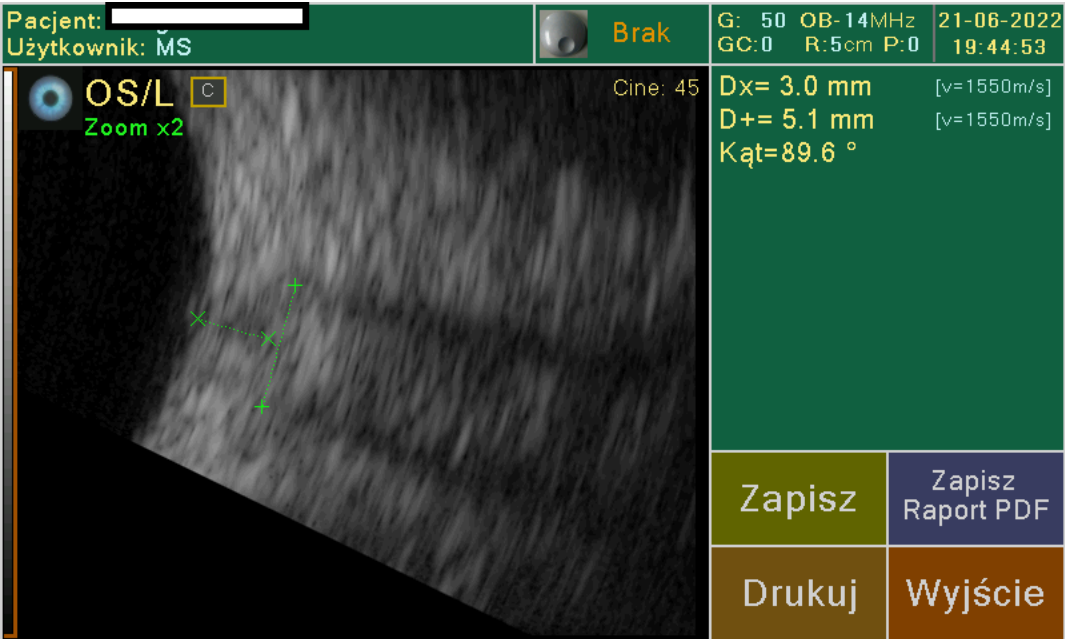


Figure 2: Left ONSD before treatment.

Second one right after phenytoin infusion - right ONSD – 5, 4 mm (Figure 3), left ONSD - 4, 6 mm (Figure 4).



Figure 3: Right ONSD just after phenytoin infusion.

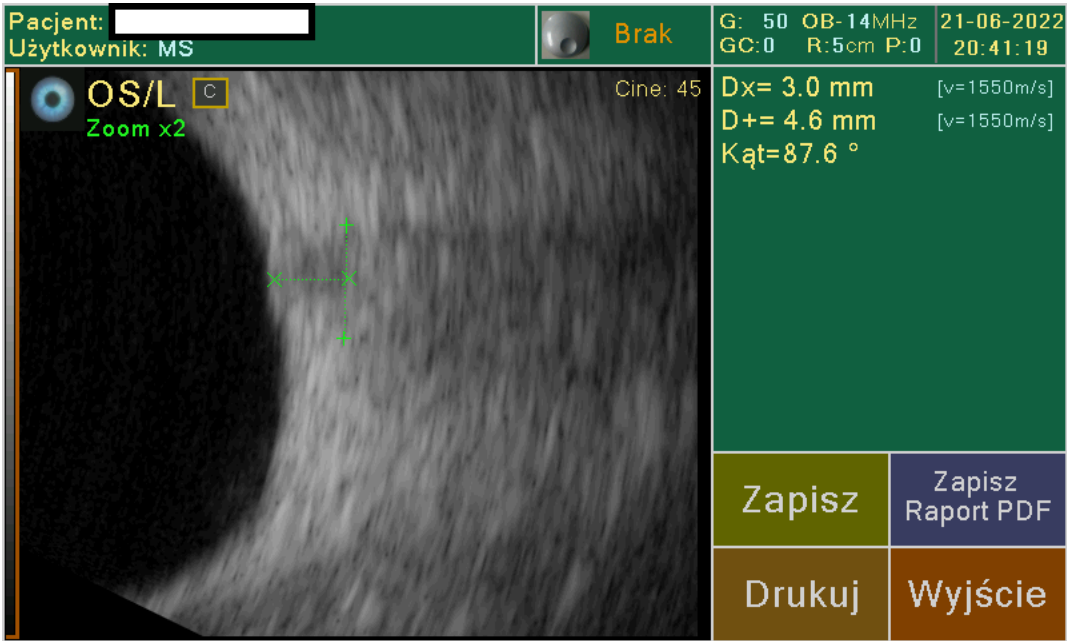


Figure 4: Left ONSD just after phenytoin infusion.

Third, one an hour after infusion ending – right ONSD - 5, 0 mm (Figure 5), left ONSD - 4, 1 mm (Figure 6).



Figure 5: Right ONSD 1 hour after phenytoin infusion.

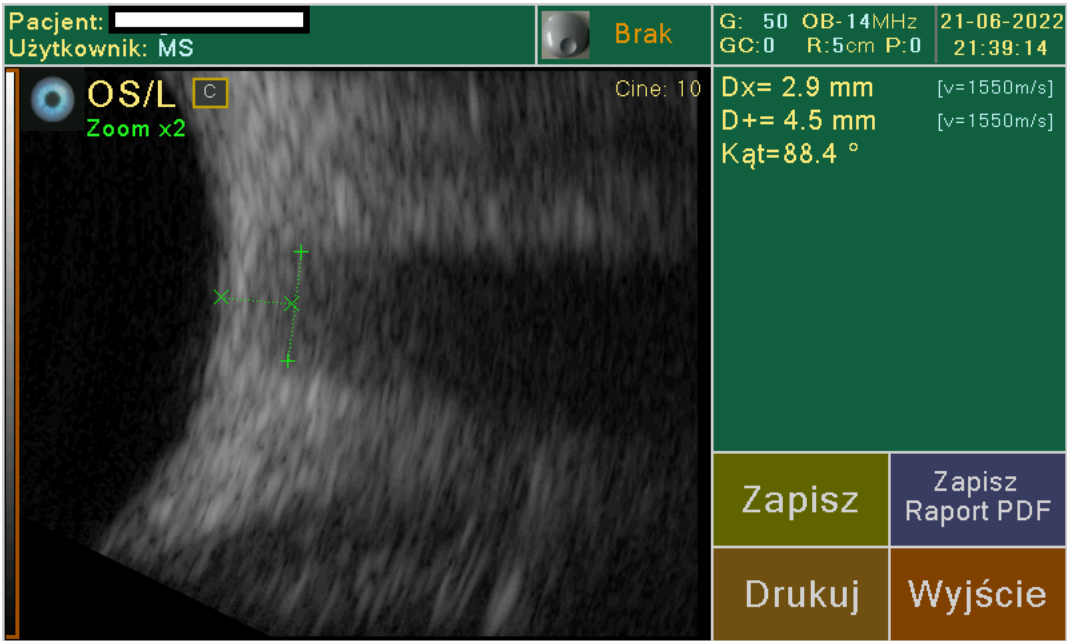


Figure 6: Left ONSD 1 hour after phenytoin infusion.

Fourth one, 3 days later, when patient presented no seizures and improvement in functioning was observed – right ONSD – 5,0 mm (Figure 7), left ONSD – 4,1 mm (Figure 8).

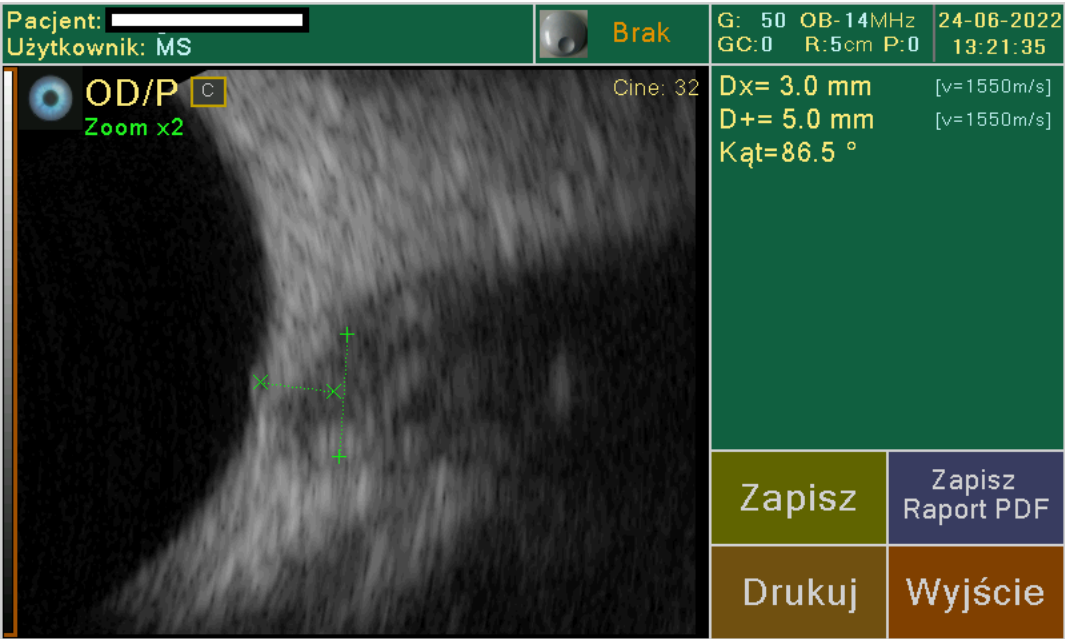


Figure 7: Right ONSD 3 days later - patient seizure-free.

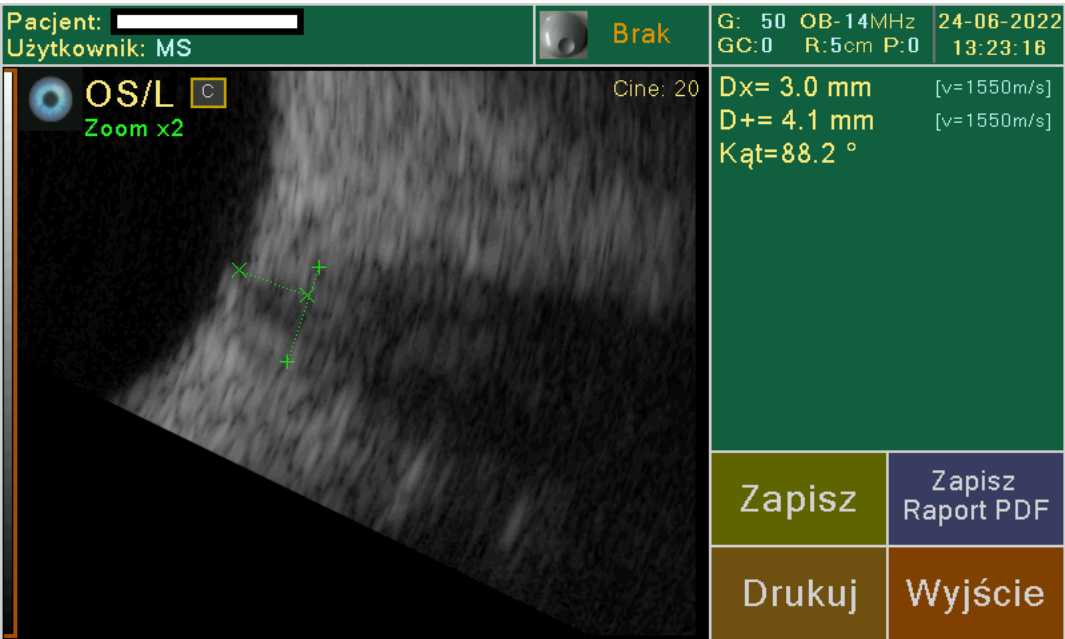


Figure 8: Left ONSD 3 days later - patient seizure-free.

Discussion and Conclusion

Our findings revealed ONSD decrease as patient’s neurological condition was improving during receiving adequate treatment. Repetitive assessment of the ICP in children remains troubling medical issue. Most accurate methods (invasive measure or MRI scan) are hard to perform in a short period and eye fundus examination lacks precision and objectivity. The ONSD measurement appears to be a proper solution, allowing clinicians to make important decisions concerning starting and modifying of anti-oedematous treatment in multitude of clinical diagnosis. There are plenty of research conducted to prove ONSD ultrasound measurements good correspondence

with lumbar puncture ICP readings and MRI scan and recent works are believed to be authorised to use it independently - to legitimate clinical picture as well as to try to detect IH cases among patients with ambiguous syndromes. [5, 6] It can be useful both in relation to objectively gathered norms in pediatric population and as repetitive readings in a single patient as the clinical state is modifying, confirming changes in disease severity, as it was in our patient. [7, 8] Authors hope for this paper to be an encouragement for other researchers to apply ONSD ultrasound in their clinical practice in order to confirm or deny its clinical usefulness in pediatric cases.

References

1. Stevens RRF, Gommer ED, Aries MJH, Ertl M, Mess WH, et al. (2021) Optic nerve sheath diameter assessment by neurosonology: A review of methodologic discrepancies. *J Neuroimaging* 31: 814-825.
2. Shah AK, Fuerst D, Sood S, Asano E, Ewing JA, et al. (2007) Seizures Lead to Elevation of Intracranial Pressure in Children Undergoing Invasive EEG Monitoring. *Epilepsia* 48: 1097-103.
3. Lee SH, Yun SJ, Kim DH (2022) Optic nerve sheath diameter measurement for predicting raised intracranial pressure in pediatric patients: A systematic review and meta-analysis. *Hong Kong J Emerg Med*; 29.
4. Potgieter DW, Kippin A, Ngu F (2011) Can accurate ultrasonographic measurement of the optic nerve sheath diameter (a non-invasive measure of intracranial pressure) be taught to novice operators in a single training session? *Anaesth Intensive Care* 39: 95-100.
5. Steinborn M, Fiegler J, Kraus V, Denne C, Hapfelmeier A, et al. (2011) High resolution ultrasound and magnetic resonance imaging of the optic nerve and the optic nerve sheath: anatomic correlation and clinical importance. *Ultraschall Med*; 32: 608-613.
6. Hansen G, Sellers EAC, Beer DL, Vallance JK, Clark I (2016) Optic Nerve Sheath Diameter Ultrasonography in Pediatric Patients with Diabetic Ketoacidosis. *Can J Diabetes* 40: 126-130.
7. Padayachy LC, Padayachy V, Galal U, Pollock T, Fieggen AG (2016) The relationship between transorbital ultrasound measurement of the optic nerve sheath diameter (ONSD) and invasively measured ICP in children. Part II: age-related ONSD cut-off values and patency of the anterior fontanelle. *Childs Nerv Syst*; 32: 1779-1785.
8. Kerscher SR, Schoeni D, Hurth H, Neunhoeffer F, Haas-Lude K, et al. (2020) The relation of optic nerve sheath diameter (ONSD) and intracranial pressure (ICP) in pediatric neurosurgery practice - Part I: Correlations, age-dependency and cut-off values. *Childs Nerv Syst*; 36: 99-106.