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Optic Nerve Sheath Diameter in Normal Indian Population as Measured with Computerized Tomographic Scan

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ABSTRACT

Introduction: Measurement of the optic nerve sheath diameter (ONSD) is gaining importance as a tool to detect increased intracranial pressure (ICP). Determining the normal ONSD is necessary to determine the cut-off value of ONSD to detect raised ICP. Since Computerized Tomographic scan (CT scan) is performed in all Neurosurgical emergencies and computer-based tools are available to measure the ONSD, CT scan measurement is also being used, apart from transorbital ultrasonography (USG). So far there is no Indian study measuring the ONSD using CT scan in normal individuals.

Materials and Methods: A prospective observational study was conducted on 1 00 adult patients without any intracranial problem for whom CT scan was performed for non-neurological conditions of head and neck. ONSD was measured at 3 mm and 8 mm behind the globe in both eyes using electronic calipers available with the Picture Archiving and Communication System (PACS).

Results: The mean ONSD measured at 3 mm behind the globe ranged between 4.42 mm and 4.84 mm. The ONSD measured at 8 mm behind the globe ranged between 4.04 mm and 4.46 mm. The mean ONSD of both sides was 4.63 mm at 3 mm behind the globe and 4.25 mm at 8 mm behind the globe. The ONSD in the left eye is slightly more than that in the right eye. There is no difference in ONSD between age groups and the sexes.

Conclusions: ONSD measurement using CT scan is a very useful noninvasive tool in predicting raised ICP, planning proper treatment, and for prognostication.

Keywords: *Optic nerve sheath diameter, Normal optic nerve sheath diameter, Noninvasive ICP measurement, CT scan measurement of optic nerve sheath diameter.*

INTRODUCTION

The optic nerve is surrounded by subarachnoid space and any change in the intracranial pressure distends the perioptic subarachnoid space, causing distension of the intraorbital part of the optic nerve sheath. Hence, measurement of optic nerve sheath diameter (ONSD) is gaining prominence as a non-invasive tool for detecting raised intracranial pressure (ICP). The ONSD can be measured using transorbital ultrasonography (USG), Computerized Tomographic Scan (CT Scan), or Magnetic Resonance imaging (MRI). Before using the ONSD routinely for detecting raised ICP, it is necessary to establish baseline values in normal populations. While several studies exist for foreign populations, Indian studies remain sparse, mostly utilizing USG. This study presents CT scan measurements of ONSD in normal Indian adults.

MATERI ALS AND METHODS

This prospective observational study included 1 00 adult patients undergoing CT scans as part of routine investigation for non-neurological conditions of the head and neck, with no symptoms or signs of intracranial lesions, following institutional ethics approval. Brain CT scans were performed using a Philips Ingenuity 64-slice scanner following standard protocols. Measurement of ONSD for both eyes was recorded at 3 mm and 8 mm behind the globe on the Medsynapse Picture Archiving and Communication System (PACS) using electronic calipers.

STATISTICAL ANALYSIS

Continuous variables were summarized as mean ± SD with range. Paired t-tests compared right vs. left ONSD and bilateral 3 mm vs. 8 mm means. Welch's independent-samples t-test compared male and female participants. Pearson correlation examined relationships between measurements. Two-sided $p < 0.05$ was considered statistically significant.

RESULTS

The cohort comprised 55 males and 45 females. ONSD values at 3 mm behind the globe were 4.42 ± 0.83 mm in the right eye and 4.84 ± 0.88 mm in the left eye. At 8 mm behind the globe, values were 4.04 ± 0.81 mm in the right eye and 4.46 ± 0.96 mm in the left eye.

The mean bilateral ONSD was 4.63 ± 0.70 mm at 3 mm behind the globe and 4.25 ± 0.69 mm at 8 mm behind the globe. The measurement at 8 mm was significantly smaller than at 3 mm ($p = 0.0001$ 5). ONSD in the left eye was significantly higher than in the right eye ($p = 0.001$ 0). No significant differences were observed across sexes (3 mm: male 4.60 mm vs. female 4.66 mm, $p = 0.672$; 8 mm: male 4.1 9 mm vs. female 4.32 mm, $p = 0.351$) or age groups.

TABLE 1 : MEAN ONSD VALUES IN DIFFERENT AGE GROUPS

Age Group (yrs)	N	3 mm behind globe (mm)			8 mm behind globe (mm)			3mm : 8mm Ratio
		Right	Left	Mean	Right	Left	Mean	
1 8–30	30	4.58 ± 0.35	4.80 ± 0.37	4.69 ± 0.34	4.1 7 ± 0.31	4.46 ± 0.33	4.31 ± 0.29	1 .09
31 –65	45	4.61 ± 0.33	4.82 ± 0.36	4.72 ± 0.33	4.21 ± 0.31	4.48 ± 0.34	4.35 ± 0.30	1 .09
>65	25	4.55 ± 0.32	4.79 ± 0.35	4.67 ± 0.32	4.1 6 ± 0.29	4.44 ± 0.32	4.30 ± 0.28	1 .09

DISCUSSION

ONSD measurement is established as a effective surrogate for indirect ICP evaluation. CT scans offer high availability and precise computer-assisted measurement using electronic calipers without operator-dependent variance seen in USG. Most authors agree that 3 mm behind the globe is the optimal measurement point due to maximum subarachnoid space distensibility.

In foreign CT studies, Vaiman et al. (201 5) reported ONSD ranges of 4.91 ± 1 .51 mm (right) and 5.1 7 ± 1 .34 mm (left) at 3 mm. Itanyi et al. (2021) observed 4.4 ± 0.5 mm at 3 mm in Nigerians. In Indian USG studies, Shirodkar et al. (201 4) reported mean ONSD of 4.6 mm in females and 4.8 mm in males, while Kalim et al. (2022) reported 4.28 ± 0.28 mm. Our CT values (4.63 mm at 3 mm) align well with these estimates.

Limitations: Small sample size; restricted to adult subjects; eyeball transverse diameter (ETD) ratio was not evaluated.

CONCLUSIONS

In normal Indian adults, mean ONSD measured on CT scan is 4.63 mm at 3 mm behind the globe and 4.25 mm at 8 mm behind the globe. Left eye measurements are slightly larger. Since CT scan is routinely performed in emergency neurosurgical admissions, standard ONSD measurement via PACS software provides a rapid, non-invasive benchmark for identifying elevated ICP (>5 mm threshold).

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