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Original Research Article

Comparison of optic nerve sheath diameter in preeclampsia and normal pregnancy using ocular USG

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ABSTRACT

Background: Measurements of optic nerve sheath diameter (ONSD) in intracranial pathologies correlate well with raised ICP. Only recently the usefulness of ocular ultrasonography in preeclampsia has been sought. Objective of current study was the measurement of ONSD in preeclampsia and compare it to healthy pregnant females.
Methods: A total of 90 subjects were included and divided into Group I- normal pregnancy (N=30), Group II - mild preeclampsia (N=30), Group III- severe preeclampsia group (N=30) and hemodynamic parameters. Optic nerve sheath diameter measurement is performed with a linear ultrasound probe placed over the eyelid with optic nerve sheath diameter measured 3 mm behind the globe. Patients with preeclampsia were compared to normal pregnant females as controls.
Results: Optic nerve sheath diameter was significantly higher in patients with preeclampsia compared to controls ($p<0.001$). The mean of ONSD in group I was 4.5±0.2 mm, versus 5.7±0.2 mm in group II, versus, 5.9±0.3 mm in group III.
Conclusions: Preeclampsia is associated with a significantly higher ONSD compared to normal pregnant females and can be used as a marker of increased ICP in preeclampsia.

Keywords: Cerebral edema, Intracranial pressure, Ocular ultrasonography, Optic nerve sheath diameter, Preeclampsia

INTRODUCTION

Preeclampsia is a progressive multisystem pregnancy disorder that is considered one of the important causes of maternal mortality worldwide. Usually, it is diagnosed by the new-onset hypertension and either proteinuria or end-organ dysfunction in the second half of pregnancy.[1,2]

An increase in ICP is one of the consequences of preeclampsia.[3] Changes in the Optic Nerve Sheath Diameter (ONSD) is an important clinical and radiographic demonstration of increased ICP.[4,5] Many studies have reported a significant relationship between increase in ICP and an increase in the optic nerve sheath diameter. Also physiologically optic nerve is surrounded by a dural sheath and a subarachnoid space containing cerebrospinal fluid, thus it can be stated that the increase in ICP exerts a pressure on the sub-arachnoid space around the optic nerve and causes the nerve sheath to expand.[6,7] Although the gold standard method for ICP measurement is based on the use of invasive devices, but it is not feasible to perform in every preeclampsia patient.[8] As per the studies conducted, the relationship between the high ICP with the diameter of the optic nerve sheath in ultrasound has been established and hence it is expected to have relationship between preeclampsia (as

one of the causes of an increased ICP) and the optic nerve sheath diameter[9] In normal adults, ONSD is 4-4.5 mm and levels above 5 or 5.5 mm (in some studies) denote raised ICP.[10] This study was devised to perform measurement of ONSD in preeclampsia and compared it to normal pregnant patients.

METHODS

After approval by institutional ethics committee and obtaining a written informed consent from patients, this study was done at SHKM, GMC Nalhar, Haryana in the time period from July 2018 to December 2019. It was a prospective randomised comparative study in which a total of 90 patients who were admitted in gynaecology department were included in the study. Exclusion criteria in current study were; patients who had history of optic neuritis, severe myopia, history of ocular surgeries, presence of ocular ulcers and any clinical or morphological conditions that prevent the ultrasound examination of the orbital area.

Included patients were allocated three groups: Group I-normal pregnancy (N=30), Group II-mild preeclampsia (N=30) and Group III-severe preeclampsia. High-frequency linear probe of 7–12 MHz was used (Micromaxx, Sonosite, USA) while all patients were kept in supine position. Using two-dimensional mode, depth of the optic nerve was localized and was marked at 3 mm behind the retinal and optic nerve junction with the help of machine caliper. At this point, transverse diameter of optic nerve was calculated. Scanning begins from lateral side of eye in coronal section and then in oblique sagittal plane measuring OSND in both the axes. ONSD measurement was conducted in two axes of transverse and oblique sagittal. Value reported corresponds to the mean of the above two values for each patient.

The instruments used in this study were ultrasound device and a checklist to record patients' medical history. Information such as age, Gravidity, Gestational age by weeks, history of preeclampsia in previous pregnancies and history of chronic hypertension were asked and noted. Standard diagnostic criteria for preeclampsia was used in accordance to American College of Obstetricians and Gynecologists definition, mild preeclampsia is defined as systolic blood pressure ≥140 mmHg and diastolic blood pressure ≥90 mmHg after 20 weeks of pregnancy, and ≥300 mg or ≥1+ proteinuria in the 24-hour urine protein test, and severe preeclampsia with systolic blood pressure of 160 mmHg or more or diastolic blood pressure of 110 mmHg or more and ≥ 2+ proteinuria, or in the absence of proteinuria, new-onset hypertension with the new onset of any of the following: thrombocytopenia: platelet count less than 100,000/dl renal insufficiency: serum creatinine concentrations greater than 1.1 mg/dl or a doubling of the serum creatinine concentration in the absence of other renal disease, impaired liver function: elevated blood concentrations of liver transaminases to twice normal concentration, pulmonary edema, new-onset headache unresponsive to medication and not accounted for by alternative diagnoses or visual symptoms.[11] Pregnant women with normal blood pressure (below 140/90 mmHg) with none of the criteria for preeclampsia were considered as pregnant women with normal blood pressure.

Statistical analysis

The continuous variables were presented as mean and standard deviation and compared using Student's t-test. The categorical data were expressed as frequency and percentage and compared using Chi-square or Fisher's exact test. All statistical analysis was performed using SPSS software version 16 and P value less than 0.05 was considered as significant.

RESULTS

There were no significant differences between the groups in terms of baseline patient characteristics (p>0.05). The demographic profile of three groups are depicted in (Table 1).

Table 1: Demographic data and hemodynamic parameters as mean±SD.

Demographic data and baseline preoperative parameters	Group I (n=30) (Normal pregnancy)	Group II (n=30) (Mild pre-eclampsia)	Group III (n=30) (Severe pre-eclampsia)	P value
Age (years)	23.6±2.5	24.8±2.2	24.9±2.8	0.52
Height (cm)	162.35±4.3	165.5±4.2	160.7±5.3	0.54
Parity	1.8±0.7	1.04±0.9	1.2±0.8	0.73
Gestational age	36.5±1.2	36.29±0.9	35.6±0.4	0.54

All the three groups were comparable in terms of age, height, gestation age and parity. Hemodynamic variables and OSND were measured and comparison done among groups is given in). As obvious from (Table 2), while heart rate were comparable, but there was a significant difference in systolic BP and diastolic BP (p<0.001) as both were significantly higher in Group II and III. Among PIH groups (Group II and III), the difference was comparable. The ONSD values were comparable for group II and Group III, but there was a highly significant difference (p<0.001) when compared to normal pregnancy group. The mean OSND values for Group II and Group III were 5.7 and 5.9 mm, respectively, while it was 4.5 mm for Group I.

Table 2: ONSD and hemodynamic parameters.

ONSD and hemodynamic parameters	Group I (n=75) (Normal pregnancy)	Group II (n=75) (Mild pre-eclampsia)	Group III (n=75) (Severe pre-eclampsia)	P value
HR	87.6±2.5	88.8±2.2	86.9±2.8	>0.05
SBP (mmHg)	107.69±4.3	154.5±9.2	172.7±9.3	<0.001
DBP(mmHg)	71.1±4.9	89.04±7.8	112.7±6.8	<0.001
ONSD (mm)	4.5±0.2	5.7±0.2	5.9±0..3	0.001

DISCUSSION

Optic nerve sheath diameter measured by ultrasound is a noninvasive method for the assessment of the risk of raised ICP. The subarachnoid spaces surrounding the optic nerve communicate with the intracranial cavity and changes in cerebrospinal fluid pressure are transmitted along the optic nerve sheath.[12] 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), 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).[13]

Ultrasound technology is commonly used in the evaluation of critically ill patients. Its use for trauma scan is a simple, non-invasive bedside procedure used.[14] The utility of ONSD as a screening tool for raised ICP during initial trauma patient evaluation is well demonstrated. A cut-off value of 0.5 cm can be used to screen for raised ICP. The sensitivity and specificity to detect ICP≥20 mmHg were 74%-100% and 63%-95%, respectively, when the cut-off value ranged from 0.50 to 0.59 cm.[15] There are various theories proposed for neurological effects of eclampsia, and a varied picture of cerebral pathology occurs. As a result, the chances of raised ICP are quite high as shown in brain imaging studies.[16,17] Monitoring of ICP is very crucial in patients with eclampsia as ICP monitoring has been shown to improve clinical pharmacological treatment of intracranial hypertension in a rising number of situations.[18] The use of routine monitors such as invasive techniques, computed tomography (CT) scan, and magnetic resonance imaging (MRI) brain are limited or not feasible. Among noninvasive tools of ICP monitoring, USG measurement of ONSD has proved its worth in several such clinical scenarios; therefore, we used this technique considering ONSD as a surrogate marker of raised ICP.[10,19]

Rajajee et al and Amini et al use invasive techniques to know cutoff value and values ranged from 4.8 to 5.9 mm. Values ≥5.8 mm have been associated with ICP levels above 20 mmHg.[15,20] Most of the articles about OSND as a surrogate marker for raised ICP came from studies done on head injury patients.[21] In our study, the mean ONSD in normal pregnant group was 4.5 (0.2 SD) mm, which was quite different from Group II and Group III. OSND values were significantly higher as they were 5.7 mm and 5.9 mm in Group II and Group III, respectively (Figure 1).

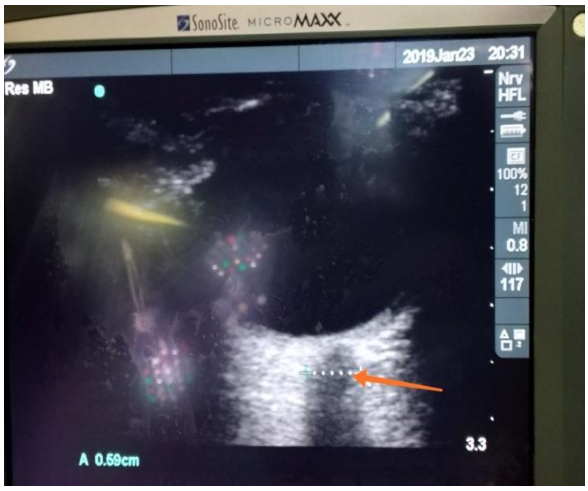

Figure 1: ONSD as measured by USG.

Similar significant difference was reported in a study conducted by Dubost and Singhvet al.[22] They compared preeclampsia to normal term antenatal cases, and they found a significant difference between these two groups (5.4 mm vs. 4.5 mm).

Our study suggests that a cut-off value for OSND could be close to 5.8 mm (as it lies in middle for mean values found in both severe PIH groups) for severe preeclampsia may progress to eclampsia. In our study, 11 (36%) in Group II and 14 (54%) in Group III had ONSD values 5.8 mm. Hence, these patients in severe preeclampsia group seem to be at greater risk for further deteriorating into eclampsia requiring immediate emergency management.

Limitations

Limitations of current study were serial follow-up and correlation with Mgso4 therapy would have been more definitive.

CONCLUSION

USG for ONSD measurement has presented itself as an exciting option for the measurement of increased ICP in preeclampsia patients and offers the advantages of being a simple, non-invasive and readily available diagnostic modality. We suggest ONSD measurement be adopted as

a point of care test in pre-eclampsia patients to assess severity and help in management.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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