EVALUATION OF RETINAL THICKNESS IN PREGNANCY USING OPTICAL COHERENCE TOMOGRAPHY

Physiology

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ABSTRACT

BACKGROUND: During pregnancy, the maternal eyes are exposed to various hormonal and haemodynamic alterations. The information regarding retinal thickness in healthy pregnant women in Indian population is limited. AIM: To measure retinal thickness in healthy pregnant women in the third trimester using Optical Coherence Tomography (OCT) and compare that with age matched healthy non-pregnant women.

METHODS: 20 healthy pregnant women (40 eyes) in the third trimester and 20 age matched healthy non-pregnant women (40 eyes) were recruited for this study. Macular and Retinal nerve fiber layer (RNFL) thickness were measured using OCT in both healthy pregnant and non pregnant women. RESULT: The mean macular thickness in pregnant women was 181.71 ± 12.33 μm at foveal, 245.5 ± 12.28 μm at superior quadrant, 234.46 ± 14.87 μm at inferior quadrant, 253.96 ± 16.4 μm at nasal quadrant. The mean RNFL thickness in pregnant women was 113.15 ± 8.81 μm in superior, inferior and nasal quadrants. P < 0.05 for superior, inferior and nasal quadrants. Mean RNFL thickness in non-pregnant women was 120.29 ± 7.14 μm in non-pregnant women respectively (p > 0.05). CONCLUSION: This study provides a normative database for the retinal thickness in healthy Indian pregnant women by optical coherence tomography.

KEYWORDS

Pregnancy, OCT, Macular Thickness, Retinal Nerve Fiber Layer Thickness.

INTRODUCTION

Pregnancy is a period of immense physiological changes. Changes in metabolism, hormone profile and blood circulation can affect normal functioning of the maternal eyes. Ocular changes may be associated with development of new conditions or the exacerbation of preexisting conditions. Knowledge of these ocular changes will help us to differentiate the physiological changes from ocular manifestation of systemic diseases and diseases pertaining to the eye in a pregnant woman.

Though there are studies on retinal changes during pregnancy, all of them were done in pathological conditions like Diabetic Retinopathy (DR), Central Serous Chorioretinopathy (CSCR) and Pregnancy induced hypertension (PIH). There is limited data on retinal changes available in normal pregnancy of Indian population.

Moloney et al found that pregnancy increased the rate of progression in DR. Poor glycemic control before pregnancy is associated with worsening of retinopathy and good glycemic control should occur before conception. Robert B Dinn et al concluded that all diabetc women should see an ophthalmologist before or shortly after becoming pregnant.

Pregnancy is considered as a risk factor for CSCR development in women. Two studies reported infrequent central serous chorioretinopathy in the third trimester in healthy pregnant women. A recent study found that pregnant women were 7.1 times more likely to develop CSCR than an age matched group without pregnancy.

Pregnancy induced hypertension (PIH) includes gestational hypertension, preeclampsia and eclampsia occurs after 20th week of pregnancy. The study by Pankaj Shah et al noticed that retinal changes were seen in 12% of patients with PIH.

In the above said conditions, the retinal thickness is found to be increased. The changes in normal pregnancy have likelihood to graduate into abnormal toxic findings. This suggests that there is no clear cut dividing line between true toxemia and normal pregnancy. The variations of retinal changes may be used to predict the possibilities of disease processes and to further increase our understanding about retina in normal and abnormal pregnancy.

The increase of fluid in the body, especially in the last trimester, may cause an increase of retinal thickness.

The introduction of Optical Coherence Tomography (OCT) has enabled clinicians to reliably detect and measure small changes in macular thickness and to quantitatively evaluate the efficacy of different therapeutic modalities.

Currently, we are using values of normal population for comparing macular thickness in pathological states of pregnancy. No normative data regarding macular thickness in pregnancy is available in Indian literature. It will be of immense help in obtaining valuable background data which can be used as control for further follow up and early detection of retinal abnormalities in pregnancy. As OCT is more widely used, normative data using the same technique is required in interpreting physiological pathological features of the retina.

OBJECTIVE:

To measure retinal thickness in healthy pregnant women in the third trimester using Optical Coherence Tomography (OCT) and compare that with age matched healthy non-pregnant women.

MATERIALS AND METHODS

This cross sectional comparative study was conducted in the departments of Physiology, Ophthalmology and OBG at Amrita Institute of Medical Sciences (AIMS), Kochi for a period of 3 months. Approval was obtained from Institutional Ethics Committee. Written informed consent was obtained from all the participants.

Participants were recruited into two groups. The study group consisted of 20 healthy pregnant women (40 eyes) in their last trimester who attended for antenatal check up in the OBG department at AIMS, while the control group consisted of 20 age matched healthy non-pregnant women (40 eyes) who were staffs working at various departments of AIMS.
Exclusion criteria for this study included prior history of any significant ocular disease, history of systemic disease such as hypertension or diabetes mellitus and the development of complications such as gestational diabetes mellitus, and pregnancy-induced hypertension (PIH).

Visual acuity, intraocular pressure, and visual field examination with automated perimeter were performed in both groups. OCT imaging of both eyes were done after mydriasis with tropicamide 0.5%.

**Optical Coherence Tomography (OCT)**

OCT is a non-invasive, non-contact, transpupillary imaging technology which can image retinal structures in vivo with a resolution of 10 to 17 microns. Cross-sectional images of the retina are produced using the optical backscattering of light. The anatomic layers within the retina can be differentiated and retinal thickness can be measured 1-3.

Traditional methods for evaluating macular edema such as slit lamp bio microscopy, stereoscopic photography and fluorescein angiography are relatively insensitive to small changes in retinal thickness.

Central foveal thickness at 1 mm, parafoveal thickness at 3 mm diameter, and RNFL (peripapillary area) thickness were the retinal parameters measured by OCT in this study. The 6 mm macular map was used to evaluate foveal and parafoveal thickness. Parafoveal thickness was recorded for upper, temporal, inferior, and nasal quadrants.

**Statistical analysis**

was carried out using IBM SPSS Statistics 20 windows software. The study evaluated data with descriptive statistical methods (mean, standard deviation) between the two groups were compared using Student’s t-test. A p value of less than 0.05 was considered statistically significant.

**RESULTS**

In the present study, 40 eyes of 20 healthy pregnant women were studied and compared with the same number of control group which included healthy non-pregnant women.

Mean age for the study group was 27.58 ± 4.75 and for the control group was 28.36 ± 5.40.

Mean gestational age of pregnant women was 33 weeks.

Mean foveal and parafoveal thicknesses (four quadrants) in the study group were: fovea181.71 ± 12.33μm, superior quadrant 245.5 ± 12.27μm, inferior quadrant 233.21 ± 12.72μm, and nasal quadrant 263.96 ± 16.4μm.

Mean foveal and parafoveal thicknesses (four quadrants) in the control group were: fovea177.58 ± 10.96μm, superior quadrant 231.21 ± 12.77μm, inferior quadrant 234.46 ± 12.72μm, and nasal quadrant 252.13 ± 13.01μm.

Mean peripapillary RNFL thickness was 113.15 ± 8.81 μm in the study group and 109.29 ± 7.14 μm in the control group respectively.

### Table 1. Mean Foveal, Parafoveal (Superior, Inferior, Temporal and Nasal) and Retinal Nerve Fiber Layer (RNFL) thickness expressed in micro meters

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Study group (40 eyes)</th>
<th>Control group (40 eyes)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fovea</td>
<td>181.71(12.33)</td>
<td>177.58(10.96)</td>
<td>0.25</td>
</tr>
<tr>
<td>Superior</td>
<td>245.5(12.28)</td>
<td>233.21(12.27)</td>
<td>0.03</td>
</tr>
<tr>
<td>Inferior</td>
<td>234.46(14.87)</td>
<td>231.21(12.72)</td>
<td>0.04</td>
</tr>
<tr>
<td>Temporal</td>
<td>220.23(14.41)</td>
<td>211.25(13.60)</td>
<td>0.24</td>
</tr>
<tr>
<td>Nasal</td>
<td>263.96(16.4)</td>
<td>252.13(13.01)</td>
<td>0.03</td>
</tr>
<tr>
<td>RNFL</td>
<td>113.15(8.81)</td>
<td>109.29(7.14)</td>
<td>0.29</td>
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</table>

**DISCUSSION**

During pregnancy, several physiological changes take place in the human body. Mostly, cardiovascular changes develop before, during, and after the delivery. There is a slight increase in both the total fluid volume of the body and the intracellular fluid volume. Studies have reported that, increased cardiac flow and volume result in an increase in ocular blood flow during pregnancy 1-5.

Macular edema is a common cause of visual loss. Abnormal fluid accumulation within the retina and a concomitant increase in macular thickness, usually result from the breakdown of the blood-retinal barrier. This can be found in those with diabetic retinopathy, preeclampsia, CSIR, which are the common pathological conditions of the eye occurring in pregnancy.

Very few studies have investigated macular thickness during normal pregnancy. We conducted a cross sectional study in forty eyes of twenty pregnant women in their third trimester by using OCT and compared the results with that of same number of age matched healthy non pregnant women. In this study, we established the normative data of macular and RNFL thickness in normal pregnant Indian women. Macula was thickest in the nasal quadrant, followed by superior quadrant and progressively less in inferior and temporal quadrants.

Means of macular thickness in foveal and parafoveal thickness were higher in pregnant women than the control group. However, the statistically significant difference in macular thickness was only found in superior, nasal and inferior parafoveal areas.

Our data showed fairly similar outcome with Demir et al, who measured macular thickness in 40 pregnant women and 37 non pregnant women in the Turkish population 6. They reported an increase of macular thickness in superior, inferior, and temporal quadrants.

Cankaya et al., have reported an increase in macular thickness during the second and third trimesters and they concluded that the increase of fluid in the body, in particular in the second and last trimester, may cause an increase of foveal thickness 7.

A recent prospective study by Farahat et al, in 26 healthy pregnant women during first, second and third trimesters showed that the central macular thickness increased in the second trimester than in the first and increased in the third trimester than in the second 8.

Our study reaffirms the fact that fluid volume in the body increases during pregnancy secondary to hormonal changes. The increase of macular thickness may be secondary to the increase and accumulation of intraocular cellular fluid and is in tune with the findings of other studies.

Regarding RNFL thickness, our study result showed no significant difference in pregnant women ( p> 0.05). Similar findings have been reported by Demir et al also.

In contrast Entezari et al documented that the mean RNFL thickness was significantly more during pregnancy in comparison with the postpartum period. They conducted the study in 32 pregnant women of Iranian population. They compared the data with the same women in the postpartum period 9. Almost similar findings were documented by M Atas et al in a comparative study including 25 healthy pregnant women and 26 healthy non-pregnant women 10.

In clinical practice, the finding of RNFL thickness in normal pregnancy might be helpful in diagnosis of retinopathy in some chronic diseases including diabetes and hypertension. Decreased RNFL thickness in these chronic diseases might be misdiagnosed in pregnancy due to pregnancy induced increased thickness 11,12.

**CONCLUSION**

Our study provides a normative database for human macular and peripapillary RNFL thickness as measured by OCT in healthy Indian pregnant women, from a statistical stand point. It is a useful data for interpreting features of retina in pathological conditions of pregnancy. Further longitudinal studies throughout pregnancy and into the postpartum period with a larger number of patients are required to confirm the changes.

**REFERENCES**