



Evaluation of changes in intraocular pressure and central corneal thickness during pregnancy and puerperium

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Article History

Volume 6, Issue 2, Feb 2024

Received: 17 Dec 2023

Accepted : 08 Jan 2024

Published : 07 Feb 2024

doi: 10.33472/AFJBS.6.4.2024.874-882

Abstract

To measure Intra Ocular Pressure (IOP) and Central corneal thickness (CCT) in each trimester of pregnancy and puerperium and to evaluate the differences in measurement of IOP and CCT in each trimester of pregnancy and puerperium Methods: 75 healthy pregnant women within age group ranging from 20 to 40 years were included in the study. IOP by Goldmann–Applanation Tonometry and CCT by specular microscopy were calculated at 4 time periods: First trimester, Second trimester, Third trimester and puerperium. Informed consent was taken from all individuals. All of the antenatal women underwent comprehensive ophthalmologic examinations, including Refraction, IOP, CCT, Anterior segment evaluation and Fundus examination. The difference in IOP and CCT during various trimesters of pregnancy and puerperium were calculated. Results: The mean age was 26 years in the study group. Paired t test was applied to compare the CCT and IOP in different phases of pregnancy. Statistically significant reduction in IOP was observed in second and third trimesters and returned to the baseline first trimester value in puerperium. (p value < 0.01) There was statistically significant elevation in CCT in the second and third trimester of pregnancy & returned to baseline first trimester value in puerperium (p value < 0.01) Conclusion: CCT is an important factor to be considered while measuring IOP. The IOP measurements in pregnant women should always be corrected for CCT thereby preventing false high or low recordings of IOP. Monitoring of IOP and CCT during pregnancy is also important in management of glaucoma patients and titrating the medication dose. This study highlights the necessity to be aware of the ocular changes that occur during pregnancy and routine ophthalmic screening during antenatal period.

Keywords: Intraocular pressure; central corneal thickness; glaucoma ; pregnancy.

1. Introduction

Traditional Pregnancy is known to cause various physiological changes in the body and the eyes are not exempt from these effects. Few studies suggest that changes in hormonal levels, fluid balance and systemic vascular changes during pregnancy may influence changes in intraocular pressure and central corneal thickness.

Intraocular pressure is the fluid pressure inside the eye and the range is between 12 to 21 mmHg. This IOP is maintained by the Aqueous humour which is secreted by the ciliary body and is then drained through the trabecular and uveoscleral outflow. Maintaining the right level of IOP is essential for the health of the optic nerve and overall structure of the eye.

Any increase in the IOP can lead to Glaucoma.¹ Glaucoma is one of the major causes of preventable blindness globally. Reducing intraocular pressure (IOP) is the only proven measure to retard or halt disease progression in studies of those at high risk of developing glaucoma. However, IOP is a highly variable and dynamic parameter, undergoing virtually sustained fluctuations from numerous factors, including body position and circadian rhythms.² IOP follows diurnal rhythm, with higher values in the early morning and lower values in the late afternoon and evening.

There is evidence to suggest that IOP may decrease during pregnancy which can be related to hormonal changes.³ However, the results from different studies are inconsistent and the relationship between pregnancy and IOP is not fully understood.

Central Corneal Thickness (CCT) can impact the accuracy of IOP measurements. Thicker corneas may result in higher IOP readings, while thinner corneas may yield lower readings.⁴ Hence, CCT should be measured in all patients to titrate the IOP value. Pachymetry test is a simple, non-invasive test to measure the corneal thickness and done with the help of a specular microscopy.

The Ocular Hypertension Treatment Study (OHTS) (5) emphasised the prognostic significance of CCT in analysing patients with ocular hypertension. The American Academy of Ophthalmology guidelines recommend that all glaucoma suspects and patients diagnosed with primary open angle glaucoma (POAG) should have CCT measurement included in the initial assessment. Demographics, environmental factors, glaucoma management and the measurement devices used have a significant effect on CCT, and should be taken into consideration when interpreting the effect of cornea thickness in patients with glaucoma. GAT reading was obtained in eyes with CCT of approximately 520µm. Every 100 µm deviation from this value would result in an error in IOP measurement of 7 mmHg. Thus, a thick cornea would result in an artefactually increased IOP reading, whereas a thin cornea would result in an artefactually reduced IOP reading. This may explain why patients with OHT have thicker corneas than the normal population and patients with glaucoma.

Pregnancy is a multifactorial & distinct phenomenon which is not only restricted to reproductive organs but also exerts its influence on various other systems of the human body.⁶ Ocular changes occur in pregnancy due to the physiological responses of the human body to cope up with the growing fetus. The severity of ocular changes is amenable to modifications owing to the health status of pregnant women in cases of diabetic or hypertensive retinopathy and glaucoma. Hormones play an influential role on physiological ocular changes in pregnancy & it's essential to be aware of such modifications & potential effects on the pre-existing condition and know complications in order to counsel the women who are currently pregnant.⁷ Routine screening of Intraocular pressure (IOP) and Corneal central thickness (CCT) during an

antenatal check-up is essential in predicting the onset of glaucoma in pregnancy induced hypertension and transient refractive changes. Gestational period is associated with several endocrine interactions and involves various homeostatic mechanisms.⁸

Aim of this study is to observe and tabulate the changes in IOP and CCT in each phase of pregnancy and postpartum period and to determine if Gestational age has an impact on IOP and CCT as the pregnancy progresses and observe trend after the delivery of the placenta

Objectives

1. To measure IOP in both eyes using Goldmann applanation tonometry in each trimester of pregnancy and puerperium
2. To measure CCT in both eyes using specular microscopy in each trimester of pregnancy and puerperium
3. To assess the relationship between gestational age with IOP and CCT of pregnant women eyes.

2. Materials and Methods

Study design: Prospective observational study

Study setting: This study was conducted by Department of Ophthalmology in a tertiary care centre

Sample size: This study was conducted in 75 healthy pregnant women aged between 20 to 40 years who came for routine antenatal check-up within a period of one year

Study methodology:

After brief explanation and informed consent, pregnant women who were willing to participate in the study were included.

Inclusion criteria:

Pregnant women aged between 20 to 40 years with a known last menstrual period

Exclusion criteria:

Pregnant women who have undergone any previous ocular surgery

Pregnant women with history of glaucoma

Pregnant women with any ocular pathology

Data collection process

All pregnant women between the age group of 20 – 40 years who fulfilled the above criteria were evaluated and included.

Subjects were then followed in subsequent trimester of that pregnancy and similar parameters were recorded.

75 pregnant women (150 eyes) with uncomplicated singleton pregnancies and with no history of any ocular diseases and no history of past ocular surgeries were examined.

They underwent comprehensive ophthalmic examinations.

Pregnant women of 1st trimester are randomly chosen who come for Antenatal checkup to ophthalmology OPD at the centre

Each pregnant woman was then evaluated for Visual acuity testing using Snellen's chart for distant vision and Jaeger's chart for near vision, Auto-refraction, IOP with Goldmann Applanation Tonometry and CCT with specular microscopy

The study groups comprised of pregnant women in the first, second and third trimester and women in puerperal stage.

The first trimester will include 1st 14 weeks of pregnancy; second trimester will include 14–28 weeks of pregnancy and the third trimester will include 24–40 weeks of pregnancy.

Puerperium is the postpartum period which is defined as the period from the end of labour till involution of uterus is complete (between 3– and 6–weeks post delivery)

The participants were called prior to their scheduled appointment.

Complete ophthalmologic examinations, including the recording of best corrected visual acuity, refraction, anterior segment and fundus examinations.

IOP and CCT was repeated & performed every 3 months during pregnancy (beginning at the first 10 weeks of pregnancy) and in their subsequently one visit any time in each trimester.

The right and left eyes were measured separately.

All measurements were performed by the principal investigator in the following order: visual acuity, auto refraction, Goldmann applanation tonometry, specular microscopy and slit lamp examination

Statistical data analysis

Data was entered in MS excel and imported to SPSS software

Paired t test was performed for the test of significance

Descriptive table was generated and appropriate statistical analysis was done using SPSS 28.0

Paired t test was applied to compare the CCT and IOP in different phases of pregnancy.

A significance level of pvalue < 0.05 was considered

The data was expressed as mean \pm standard deviation

3. Results

The mean age of study group was 26.77 years in the study group. (SD= 3.758)

73 % were primigravida and 27 % were multigravida

65 % had no systemic co morbidities; 25 % were diagnosed with gestational diabetes mellitus and remaining 15% were diagnosed with gestational induced hypertension during the course of gestation.

A total of 75 subjects of the age–group of 20–40 years participated in this study. The IOP of the pregnantwomen the variation was compared in each trimester.

There was a significant decrease in the IOP in the third trimester of pregnancy (p <0.01) as compared to that in the second trimester of pregnancy and returned to baseline first trimester values of IOP in puerperal stage

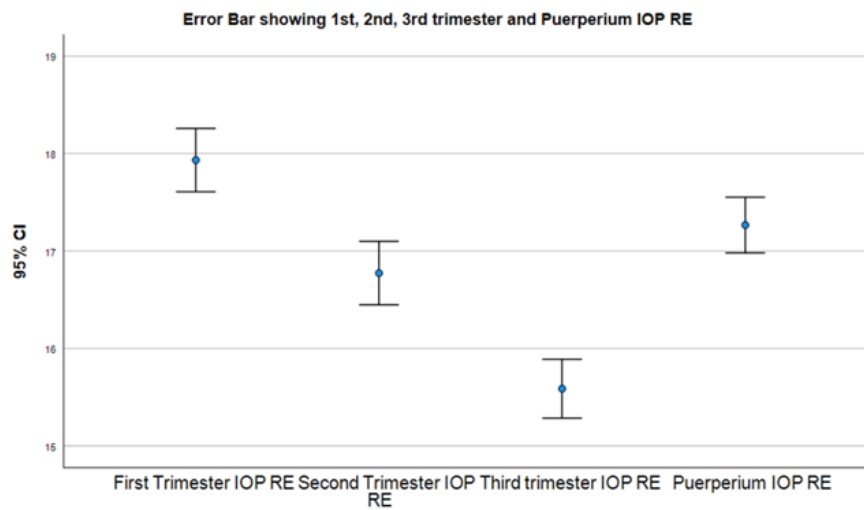
There was a significant increase in the CCT in the third trimester of pregnancy (p <0.01) as compared to that in the second trimester of pregnancy and returned to baseline first trimester values of CCT in puerperal stage

Table 1: Comparison of Intraocular pressure during pregnancy and puerperium

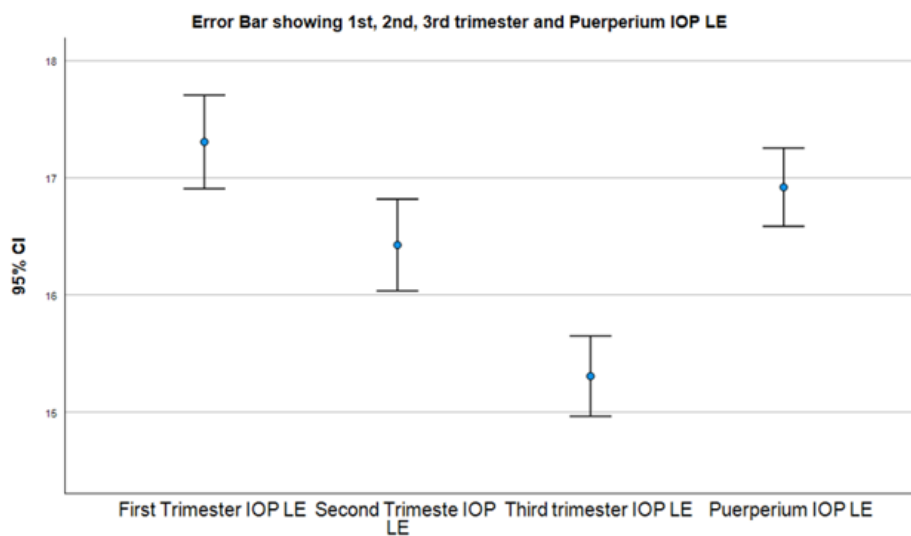
Trimester	Right eye			Left eye		
	Mean	Standard deviation	P value	Mean	Standard deviation	P value
1 st	17.93	1.408	<0.01	17.31	1.732	<0.01
2 nd	16.77	1.420	<0.01	16.43	1.702	<0.01
3 rd	15.59	1.316	<0.01	15.31	1.488	<0.01
Puerperium	17.27	1.245	<0.01	16.92	1.450	<0.01

Decrease in IOP is observed in 2nd and 3rd trimester as compared with that of 1st trimester and

returned to baseline first trimester values in puerperal stage



Graph 1

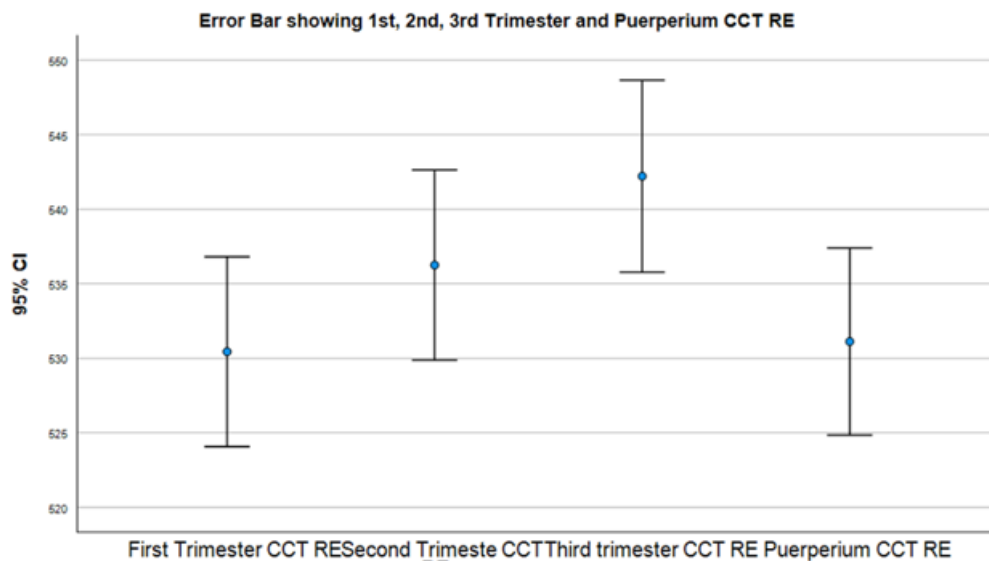


Graph 2:

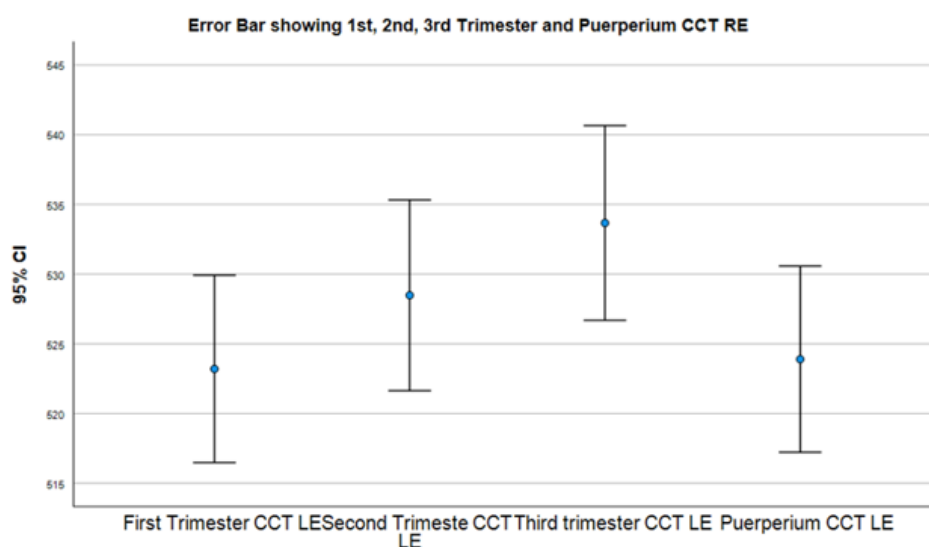
Table 2: Comparison of Central corneal thickness during pregnancy and puerperium

Trimester	Right eye			Left eye		
	Mean	Standard deviation	P value	Mean	Standard deviation	P value
1 st	530.44	27.693	<0.01	523.20	29.187	<0.01
2 nd	536.25	27.735	<0.01	528.48	29.720	<0.01
3 rd	542.21	27.974	<0.01	533.67	30.367	<0.01
Puerperium	531.12	27.262	<0.01	523.89	29.012	<0.01

Increase in CCT is observed in 2nd & 3rd trimester as compared with that of 1st trimester and returned to baseline first trimester values in puerperal stage



Graph 3



Graph 4

4. Discussion

Earlier studies have revealed the outcome of pregnancy on the eyes, along with new changes, and pre-existing ocular disorders, may change their due course owing to the extensive hormonal and other changes during gestation that may either aggravate or improve.

Hormonal & cardiovascular changes during pregnancy predispose to ocular changes.⁹ Elevated levels of oestrogen, progesterone and other placental hormones during gestation play a vital role in maintaining the IOP.

Razeghinejad MR et al.¹⁰ stated Glaucoma, primarily a disease of the elder population, may affect women of childbearing age. Pregnancy affects the intraocular pressure of women with pre-existing glaucoma. Both elevations and reductions of IOP have been reported during pregnancy.

During pregnancy, the aqueous production is normal, but the aqueous out flow facility raised due to the influence of increased progesterone and the beta subunit of the HCG levels and reduced episcleral venous pressure which is proportional to a generalized reduction in the peripheral vascular resistance.¹¹ This results in a gradual, statistically significant fall of the IOP during pregnancy.

According to Devdas et al., there was a strong correlation between increase in BP and IOP which was observed in comparison between normotensive antenatal mothers and gestational

induced hypertensive mothers.¹²

The physiological changes in late pregnancy may reduce corneal rigidity, making the results of applanation tonometry falsely low.¹³ Similarly, an increase in corneal thickness could also affect the measured values of IOP. It should be emphasized that despite the apparent reduced IOP level in pregnant women many glaucoma patients still need to continue treatment since glaucoma damage may advance during pregnancy and progressive visual field loss can occur.

Progesterone has glucocorticoid antagonistic properties that counteract resulting in reduction of IOP.¹⁴ Alterations in the aqueous dynamics are in accordance with the hypothesis that excess progesterone, during pregnancy, blocks the ocular hypertensive effect of endogenous corticosteroids. Aqueous humour formation & its production remain constant whereas IOP decreased throughout the trimesters and returned to baseline at 3 months postpartum. Suggested mechanisms depict the decrease in IOP during pregnancy due to its association between female hormones and increased outflow.¹⁵

The decrease in the IOP could confer an advantage to patients' who suffer from glaucoma. Hence, along with the routine antenatal investigations, it is important to be aware of the IOP changes during pregnancy, to focus on the early diagnosis and prevention of pre-eclampsia in pregnant women

Physiological changes in corneal thickness occur during pregnancy.¹⁶ It was observed in our study that antenatal mothers diagnosed with gestational diabetes had central corneal thickness higher than that of antenatal mothers which was in accordance with Priya et al. which assessed the quality of life amongst antenatal mothers and analysed antenatal mothers diagnosed with co morbidities during course of pregnancy.¹⁷

In a study done by Atlas M et al., they found that there was a rise in various anterior chamber parameters like corneal volume, corneal thickness, and corneal curvature in the third trimester. The observations of our study were similar to this study regarding central corneal thickness which was increased in the third trimester.¹⁸

As per study done by D. Pizzarello Louis et al., significant change in the central corneal thickness and intraocular pressure were noted in pregnant women during their 2nd and 3rd trimesters which was also similar to our study.¹⁹ According to Sen et al.,²⁰ the CCT values were higher in pregnant women but was not statistically significant.

The probable reason for elevation in corneal thickness in pregnant women is due to corneal oedema which occurs as a result of increased retention of water by the tissues

Differentiating between pathological eye disease from physiologic ocular changes is significant in order to establish an individualized treatment or preventive plan and forms the mainstay of obstetric ophthalmology. This customised approach should always weigh the ocular benefits of treatment to the mother against the potential harms to the fetus.

5. Conclusion

Surveillance of IOP and CCT during each trimester of pregnancy plays a crucial role in managing glaucoma patients during pregnancy.

Intraocular pressure changes is one of the main changes occurring in the eye which are usually reversible and resolve in the postpartum period

Measurement of IOP is influenced by CCT and this may lead to errors in the calculation of the true IOP. CCT is usually taken into account while diagnosing glaucoma and also while setting target pressures. IOP has been shown to be a major predictor and also a modifiable risk factor

for glaucoma diagnosis and progression. Most of the anti-glaucoma medications belong to group C of the FDA classification, hence the treatment of glaucoma diagnosed during pregnancy or prior to conception is of paramount importance for both the mother and the foetus. Therefore, accurate measurement of the IOP and thereby setting a target pressure is of prime importance for calculation and adjustment of the dosages of the anti-glaucoma medication.

Routine antenatal check-up should also include ophthalmic examination as a part of screening tool for detecting the ocular changes during pregnancy

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Cite this article as: Dr. S. Minisha Paul Bravian Evaluation of changes in intraocular pressure and central corneal thickness during pregnancy and puerperium, *African Journal of Biological Sciences.* 6(4), 1-11. doi: 10.33472/AJBS.6.4.2024.1-11