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Variations Occurring in Intraocular Pressure and Refraction during Pregnancy

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ABSTRACT

Background: pregnancy represents an important challenge in the female's life that she needs close observation during it and also needs counseling by her physician about the changes that are going through her body in this stressful period.

Aim of the Work: the purpose of our study was to detect the changes that occur in the women's eyes during pregnancy and postpartum period regarding intraocular pressure and refraction.

Patients and Methods: we studied 40 pregnant healthy women whose ages ranged from 18 to 35 years and we exclude any ocular diseases such as keratoconus, amblyopia or diabetic retinopathy. We measured the intraocular pressure using a Goldmann applanation tonometer, best corrected visual acuity using the Snellen's chart and k reading using autorefractor-keratometer.

Results: we found that the IOP decreases only in the 3rd trimester with more decrease in women with multiple fetuses and multiple pregnancies. We found that the BCVA decreases only in the 2nd and 3rd trimesters. We also found that the K reading increases only in the 2nd and 3rd trimesters. Intraocular pressure, best corrected visual acuity and k reading returned to the normal values after delivery.

Conclusion: the physiologic changes that occur in the women's eyes during pregnancy and postpartum period are usually marked in second and third trimester; this is because at this period, hormonal activity is at its peak, and however these changes are transient because several weeks postpartum, all hormonal activities return to their prenatal levels.

Keywords: Intraocular Pressure, Keratoconus, Amblyopia, Goldmann Applanation Tonometer, Autorefractor-Keratometer.

INTRODUCTION

Pregnancy represents a serious challenge to all body systems. The progressive physiological changes that occur are important to support and protect the fetus and prepare the mother for delivery. These physiologic changes involve cardiovascular, renal, pulmonary, hormonal, metabolic, hematologic, immunologic, and visual systems. If there is clinical or sub-clinical pathology, these physiologic changes can lead to significant problem on already compromised systems [(1)].

The ocular changes occurring during pregnancy could be physiologic, pathologic, or modification of a pre-existing disease, the most common is the proliferative diabetic retinopathy [(2, 3)].

Most of the physiologic changes that occur because of pregnancy are marked in the third trimester. This is because at this time, hormonal activity is at its peak. However, these changes are temporary because several weeks after delivery, all hormonal activities return to their normal level [(4)].

Intra ocular pressure (IOP) decreases during pregnancy, studies in healthy women have reported a statistically significant decrease in IOP during pregnancy compared with non-pregnant women. IOP decrease as pregnancy progresses [(5)].

Cornea may show changes in sensitivity, thickness or curvature. Corneal sensitivity decreases with other changes occurring in pregnancy. An increase in corneal thickness due to edema has been documented to occur in pregnancy. An increase in corneal curvature also has been documented during the second and third trimesters which returned to its normal value after delivery. Changes in thickness may affect the refractive index of the cornea leading to changing refraction, many women complain contact lens intolerance during pregnant. This is could be due to the increase in corneal curvature and thickness. The pregnant women advised to wait until at least several weeks after delivery to obtain a new glasses prescription or new contact lens [(6)].

Visual affection and other ocular changes are rare during pregnancy. They developed in 15% of pregnant women and mostly not harmful, but are a cause of anxiety

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among the women who have these changes. One in six pregnant women has a change in the tear film or eyeglass prescription which are the most common causes for referral for an outpatient ophthalmological examination [5].

Other questions asked by pregnant women and their physicians about the diagnostic and therapeutic use of ocular drugs, the significance of pre-existing ocular diseases during pregnancy and the relation of these diseases to the choice of delivery method [5].

AIM OF THE WORK

The purpose of our study is to detect the changes that occur in the women's eyes during pregnancy and postpartum period regarding intraocular pressure and refraction.

PATIENTS AND METHODS

Study Design:

This is cohort prospective study which conducted on 40 pregnant women at duration of 12, 24 and 36 weeks of pregnancy and 6 weeks post-partum.

The study was approved by the Ethics Board of Al-Azhar University.

Inclusion criteria:

- Pregnant women (aged 18-35) with normal pregnancy.

Exclusion criteria:

- Abnormal pregnancy (any aborted or preterm delivery)
- Corneal opacity or Keratoconus.
- Trauma.
- Ambylopia.
- Diabetic eye diseases or any posterior segment diseases.

Methods:

All pregnant women were recruited at the antenatal clinic of the Department of Obstetrics and Gynecology, Fayyuom University Hospital and El-Hussien University Hospital in the period between February 2017 and January 2018.

All pregnant women were subjected at the discovery of pregnancy to

1) Complete obstetric sheet with inquiry about the following:

- Date of the discovery of the pregnancy.
- Primigravida or multigravida.
- Number of fetuses.
- Any complication concerning pregnancy (e.g bleeding, anemia, placenta previa, etc …).
- Any visual complaints during pregnancy (e.g diminution of vision, scotomas, metamorphopsias, photopsias, transient loss of vision, headache, etc …).

2) Complete ophthalmic sheet with inquiry about the following:

- State of vision before pregnancy.
- If she wears glasses? What is the type of error of refraction?
- If she was glaucomatous and what medications?
- If she has visual field defects?
- If she was cataractous before pregnancy?
- What medications she was on?
- Does she had any chronic illness(SLE, EN, T.B, etc …).
- Did she undergo any ocular operation before (e.g squint, retinal detachment, ptosis, LASIK, etc …).

3) The IOP was measured using a Goldmann applanation tonometer.

4) Keeler Vantage plus Indirect ophthalmoscope.

5) Topcon-kr-8000-pa-autorefractor-keratometer.

6) Topcon SL-D8Z Digital-Ready Zoom Slit lamp.

Statistical Analysis

Data were collected and coded to facilitate data manipulation and double entered into Microsoft Access and data analysis was performed using Statistical Package of Social Science **(SPSS)** software version 18 in windows 7.

Simple descriptive analysis in the form of numbers and percentages for qualitative data, and arithmetic means as central tendency measurement, standard deviations as a measure of dispersion for quantitative parametric data.

Quantitative data included in the study was first tested for normality by One-Sample Kolmogorov-Smirnov test in each study group then inferential statistic tests were selected.

- **Bivariate Pearson correlation test** was used to test association between variables.
- **General linear model** was used to compare repeated measures.

The **P-value ≤ 0.05** was considered significant.

RESULTS

- Obstetric data among study group.

Variables	Number (n=40)	%
Number of fetus		
One	32	80%
Two	6	15%
Three	1	2.5%
Four	1	2.5%
Gravida		
Primi	24	60%
Multi	16	40%

Table (1): This current study included forty (40) pregnant women with the majority of them (80%) were pregnant in single fetus, 15% had twins, and 2.5% had three and four fetuses. Also 60% of cases were primigravida versus 40% were multigravida.

- Description of patients' age among study group.

Parameter	Age (years)
Minimum	21
Maximum	33
Mean	26.9
SD	3.5

Table (2): Table illustrates that the mean age of cases was (26.9 ±3.5) years old ranged between 21 and 33 years old.

- Description of ophthalmological data in the 1st trimester among study group.

Variables	Minimum	Maximum	Mean	SD
BCVA	0.8	1	0.9	0.07
IOP	11	19	15.5	2.3
K	39.5	48	42.9	2.2

Table (3): Table illustrates that during the first trimester the mean BCVA was (0.9±0.07), IOP was (15.5±2.3), and mean K was (42.9±2.2).

- Description of ophthalmological data in the 2nd trimester among study group.

Variables	Minimum	Maximum	Mean	SD
BCVA	0.6	1	0.8	0.1
IOP	11	19	15.4	2.4
K	40	48	43.1	2.1

Table (4): Table illustrates that during the second trimester the mean BCVA was (0.8±0.1), IOP was (15.4±2.4), and mean K was (43.1±2.1).

- Description of ophthalmological data in the 3rd trimester among study group.

Variables	Minimum	Maximum	Mean	SD
BCVA	0.6	1	0.82	0.1
IOP	8	16	12.6	2.7
K	40.5	48.5	43.7	2.03

Table (5): Table illustrates that during the third trimester the mean BCVA was (0.82±0.1), IOP was 12.6 (2.7±), and mean K was (422.7±2.03).

- Description of ophthalmological data in the postpartum period among study group.

Variables	Minimum	Maximum	Mean	SD
BCVA	0.8	1	0.94	0.07
IOP	10	18	15.1	2.3
K reading	39.5	48	42.9	2.1

Table (6): Table illustrates that during the postpartum period the mean BCVA was (0.94±0.07), IOP was (15.1±2.3), and mean K was (42.9±2.1)

- Comparisons of BCVA level over pregnancy three trimesters and postpartum period among study group.

Variables	BCVA		p-value	Sig.
	Mean	SD		
1st trimester	0.95	0.07	**<0.001**	**HS**
2nd trimester	0.89	0.11		
3rd trimester	**0.83**	0.13		
Postpartum	0.94	0.07		

Table (7): Table illustrates that there is statistically significant **decrease** in BCVA level when progress in pregnancy with **lowest** mean in 3rd trimester then **increase** again in postpartum period, with p-value <0.05; which indicate the **negative** effect of pregnancy on BCVA level.

- Comparisons of IOP level over pregnancy three trimesters among study group.

Variables	IOP		p-value	Sig.
	Mean	SD		
1st trimester	15.5	2.3	**0.001**	**HS**
2nd trimester	15.4	2.4		
3rd trimester	**12.6**	2.7		
Postpartum	15.1	2.3		

Table (8): Table illustrates that there is statistically significant **decrease** in IOP level when progress in pregnancy with **lowest** mean in 3rd trimester, then **increase** again in postpartum period with p-value <0.05; which indicate the **negative** effect of pregnancy on IOP level.

- Correlation between IOP with patients' age of patients among study group.

IOP	Age (years)		
	r	p-value	Sig.
1st trimester	-0.18	0.3	NS
2nd trimester	-0.19	0.2	NS
3rd trimester	-0.23	0.2	NS
Postpartum	-0.18	0.3	NS

Table (9): Table illustrates that there is no statistically significant correlation with p-value <0.05 between age and IOP follow up in all pregnancy follows up on both sides.

- Correlation between IOP with Number of fetuses among study group.

IOP	Number of fetuses		
	r	p-value	Sig.
1st trimester	**-0.40**	**0.01**	**S**
2nd trimester	**-0.44**	**0.005**	**HS**
3rd trimester	**-0.54**	**<0.001**	**HS**
Postpartum	**-0.36**	**0.02**	**S**

Table (10): Table illustrates that there is statistically significant **negative** correlation with p-value <0.05 between number of fetuses and IOP in all pregnancy and postpartum period follows up, which indicated **increasing** in number of fetuses will be associated with **decrease** in IOP measure.

- Correlation between IOP with gravidity among study group.

IOP	Gravidity		
	r	p-value	Sig.
1st trimester	-0.29	0.07	NS
2nd trimester	-0.29	0.07	NS
3rd trimester	**-0.56**	**<0.001**	**HS**
Postpartum	-0.15	0.62	NS

Table (11): Table illustrates that there is statistically significant **negative** correlation with p-value <0.05 between gravidity and IOP measure in 3rd trimester, which indicate that increasing in gravidity will be associated with **decrease** in IOP measure during 3rd trimester. On the other hand there is no statistically significant diff correlation with p-value >0.05 at first or second trimester and postpartum.

- Comparisons of K level over pregnancy three trimesters among study group.

Variables	K		p-value	Sig.
	Mean	SD		
1st trimester	42.9	2.2	0.1	NS
2nd trimester	43.1	2.1		
3rd trimester	43.7	2.03		
Postpartum	42.9	2.2		

Table (12): Table illustrates that there is no statistically significant **difference** in K level when progress in pregnancy; which indicate **no** effect of pregnancy on K level.

DISCUSSION

Pregnancy leads to many hormonal changes in the body systems including the eyes. These ocular changes could be physiologic, pathologic, or a modification of a pre-existing diseases [2, 3].

Most of the physiologic changes that occur because of pregnancy are marked in the third trimester. This is because at this time, hormonal activity is at its peak. However, these changes are temporary because several weeks after delivery, all hormonal activities return to their normal level [4].

This present study investigated some physiological changes in the eye during pregnancy and 6-week postpartum in an attempt to establish baseline values in our environment and ensure better eye care for pregnant women. The purpose of our study was to detect the changes that occur in the women's eyes during pregnancy and postpartum period regarding intraocular pressure and refraction including BCVA and K readings. In our study we compared trimester-related IOP changes There was no change in IOP in the 1st and 2nd trimester, but the decrease in IOP was detected only in third trimester, this agrees with the study of **Qureshi *et al.*** [5] and differs from the studies of **Pilas-Pomykalska *et al.*** [7] that reported change in IOP through all months of pregnancy, this may be due to large number of cases (117 pregnant women).

This decrease in IOP could be due to an increase in the hormonal level of progesterone and estrogen which lead to dilatation of the circulatory system vessels leading to decrease arterial pressure and reduction in aqueous humor production [7].

Others explain the decrease of IOP as a result of relaxin release from the corpus luteum of the ovary, the breast and the placenta during pregnancy which causes relaxation of the pelvic ligaments; this effect is believed to be extended to the corneoscleral envelope to produce decreased ocular rigidity and cause a reduction in IOP [7].

In our study IOP decrease was about 1-2 mmhg which agrees with the study of **Ebeigbe *et al.*** [8], but differs from the study of **Mackensen *et al.*** [6] that mentioned drop in IOP 2-4 mmhg, this may be due to wider research among large number of cases in his study as he reported changes in 160 cases while we had 40 cases in our study. In our study IOP returns to his normal values 6 weeks after delivery which agrees with the most of studies and untill recent no other studies reported that the changes in IOP persist after delivery. In our study, there was statistically significant **negative** correlation with p-value <0.05 between number of fetuses and IOP in all pregnancy and postpartum period which indicate that **increasing** in number of fetuses will be associated with more **decrease** in IOP measure.

These reports are similar to those from a previous study by **Saylik and Safiye** [9] who reported that the number of fetuses might be associated with the degree of exaggeration. They attributed these changes to a greater increase in serum levels of progesterone, estrogen, b-human chorionic gonadotropin, cortisol, and alpha-fetoprotein in multiple pregnancies. The results from our study may not be conclusive enough because only eight of the pregnant women had multiple fetuses. Further studies may reports be required to investigate the effect of number of fetuses on IOP.

In our study there was statistically significant **negative** correlation with p-value <0.05 between gravidity and IOP measure in 3rd trimester on both eyes, which indicate that increasing in gravidity will be associated with more **decrease** in IOP measure during the 3rd trimester. These reports are similar to those from a previous study by **Qureshi *et al.*** [5] who noted that the exact reason for the lower mean IOP in third-trimester multigravidae than in

primigravidae at the same stage of pregnancy is not known. In the third trimester, the primigravida feels a mounting tension and increasing discomfort and is eager for labour to begin. During this stage, fears of physical pain or injury may cause insomnia and depression, but the multigravida is usually more relaxed. These psychological differences between multigravidae and primigravidae may be the cause of the IOP difference between them in the last trimester of pregnancy.

In our study we compared trimester related best corrected visual acuity (BCVA) changes at 12, 24, 36 week of pregnancy and 6 weeks postpartum. There was no change in BCVA in the 1st trimester, but the decrease in BCVA was detected only in 2nd and 3rd trimesters. These results are similar to those from a previous study by **Abu Samra** [(1)], but differ from the study of **Mehdizadehkashi *et al.*** [(10)] which reported the changes during the three trimesters of pregnancy, this may be due to wider research among large number of cases in their study as they reported changes in one hundred and seventeen participants while we had only 40 cases in our study.

In our study postpartum visual acuity returns to pre-pregnancy state, it was obvious that most of cases returned to their old glasses gradually, this agrees with the studies of **Mehdizadehkashi *et al.*** [(10)] and **Pizzarello** [(11)].

This decrease in BCVA could be due to hormonal changes during pregnancy which cause water retention leading to corneal edema [(12)]**.** Others explain the decrease of BCVA as a result of influx of water into the lens leading to refractive changes toward myopic range [(6)]**.**

We compared trimester related average k-reading changes using Autokeratometer measurements were recorded at 12, 24, and 36 weeks of pregnancy and 6 weeks postpartum. There was no change in k-reading in the 1st trimester, but the increase in k-reading was detected only in 2nd and 3rd trimesters, but not statistically significant. These results are similar to those from a previous study by **Efe *et al.*** [(13)] who reported that there is increase in keratometry values in central and peripheral corneal thickness which are most likely due to water retention and usually return to the normal value after delivery.

CONCLUSION

We conclude that physiologic changes that occur in the women's eyes during pregnancy and postpartum period are usually marked in second and third trimester, this is because at this period, hormonal activity is at its peak, however these changes are transient because several weeks postpartum, all hormonal activities return to their prenatal levels.

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