

ORIGINAL RESEARCH ARTICLE

Intraocular Pressure in Pregnant and Non-Pregnant Nigerian Women

Ebeigbe J A¹, Ebeigbe P N² and Ighoroje A D A³

¹Department of Optometry, Faculty of Life Sciences, University of Benin, Benin City; ²Department of Obstetrics and Gynaecology, College of Health Sciences, Delta State University, Abraka; ³Department of Physiology, School of Basic Medical Sciences, University of Benin, Benin City, Nigeria

*For correspondence: Email: jenniferebeigbe@yahoo.com Tel: +2348023470140

Abstract

A number of hormones are known to affect intraocular pressure. Of these, the female sex hormones are the predominant ones to cause variations in intraocular pressure. The aim of this study was to determine if variation in sex hormones in pregnancy affects intraocular pressure. This study was a longitudinal one. 117 pregnant women aged 20 to 35 years in their first trimester of pregnancy were followed longitudinally throughout the course of pregnancy, and six weeks post partum. One hundred non pregnant women with a regular menstrual cycle of 26-29 days were also recruited and examined for changes in intraocular pressure. Intraocular pressure was measured with the handheld Kowa applanation tonometer. Mean Intraocular Pressure (MIOP) was 14.7 ± 2.2 mmHg, 13.2 ± 2.0 mmHg and 11.0 ± 1.3 mmHg in the three trimesters respectively. There was thus a fall in Intraocular Pressure during pregnancy and this was highly statistically significant ($P < 0.0001$). At 6 weeks postpartum MIOP increased to 14.2 ± 1.8 mmHg. The difference between the mean values of Intraocular Pressure in the third trimester and 6 weeks postpartum was also statistically significant $P < 0.0001$. Intraocular pressure decreased as pregnancy advanced. Postpartum, there was increase in intraocular pressure to near pre pregnant level. The difference in mean IOP between the pregnant and non pregnant women was statistically significant ($P < 0.05$) (*Afr J Reprod Health 2011; 15[4]: 20-23*).

Résumé

Pression intraoculaire chez les femmes nigérianes enceintes et non enceintes. Il est connu que certaines hormones affectent la pression intraoculaire. Parmi elles, les hormones sexuelles de la femme constituent les hormones prédominantes pour provoquer des variations dans la pression intraoculaire. Cette étude a pour objectif de déterminer si la variation des hormones sexuelles dans la grossesse affecte la pression intra oculaire. Il s'agissait d'une étude longitudinale. Cent dix-sept femmes enceintes âgées de 20 à 35 ans qui étaient dans leur premier trimestre de grossesse ont été suivies de manière longitudinale tout au long de la grossesse et six semaines post-partum. Nous avons aussi recruté et examiné cent femmes enceintes qui avaient un cycle menstruel régulier de 26 à 29 jours pour déterminer les modifications dans la pression intraoculaire. La pression intraoculaire a été mesurée à l'aide de l'aplanométrie à main de Kowa. La pression Intraoculaire Moyenne (PIM) était de $14,7 \pm 2,2$ mmHg, $13,2 \pm 2,0$ mmHg et $11,0 \pm 1,3$ mmHg dans les trois trimestres respectivement. Il y avait ainsi une chute de la Pression Intraoculaire pendant la grossesse, ce qui était hautement statistiquement significatif ($p < 0,0001$). A la fin de six semaines de postpartum, la PIM a augmenté jusqu'à $14,2 \pm 1,8$ mmHg. La différence entre les valeurs moyennes de la pression intraoculaire dans le troisième semestre et le postpartum de de six semaines était aussi statistiquement significative ($p < 0,0001$). La pression intra oculaire a diminué au fur et à mesure que la grossesse avançait. Il y avait une augmentation de la pression intraoculaire qui atteignait presque le niveau de pré-grossesse. La différence par rapport à la PIO moyenne entre les femmes enceintes et les femmes non-enceintes statistiquement significative ($p < 0,05$). (*Afr J Reprod Health 2011; 15[4]: 20-23*).

Keywords: Intraocular pressure, Hormone, Postpartum, Pregnancy, Estrogen

Introduction

Pregnancy is the period during which a woman carries a developing foetus in the uterus¹. This period is from

conception to the delivery of the foetus. The duration of pregnancy is about 280 days or 40 weeks or 9 months and 7 days which is counted from the first day of the last menstrual cycle¹⁻³.

The state of pregnancy results in a lot of hormonal changes in the body and the eyes are no exception. These ocular changes could be physiologic, examples include changes in refractive state, visual fields, cornea sensitivity, intraocular pressure and dry eye. Pathologic changes include central serous chorio retinopathy. There could also be a modification of a pre-existing condition. The most significant modified pre-existing condition is diabetic retinopathy which worsens during pregnancy. Glaucoma on the other hand has been reported to improve during pregnancy⁴⁻⁸.

Most of the physiologic changes that occur as a result of pregnancy are usually marked in the third trimester. This is because at this period hormonal activity is at its peak⁹. A pregnant woman at term is said to produce as much estrogen as a non pregnant woman would in three years¹⁰. However, these changes are transient because several weeks postpartum, all hormonal activities return to near pre-pregnant state^{9,10}.

Raised intraocular pressure (IOP) is known to be a risk factor for glaucoma. A number of hormones are known to affect intraocular pressure. Of these, the female sex hormones are the predominant ones to cause variations in intraocular pressure. This is because sex hormones are steroids and steroids have an effect on salt and water metabolism. This leads to increase in total body fluid content which builds up in the spaces between cells causing water retention^{11,12}.

Glaucoma is most commonly found in adults over the age of 40, but will occasionally occur in females of childbearing age. Often, women will have had preexisting glaucoma which originally began in childhood or glaucoma secondary to other conditions such as uveitis or diabetes. The treatment of glaucoma in and around pregnancy offers the unique challenge of balancing the risk of vision loss to the mother with potential harm to the fetus or newborn¹³.

Previous studies¹⁴⁻¹⁶ on ocular changes in Caucasian women during pregnancy showed that because of hormonal influences, pregnancy brings about changes in refractive status, cornea sensitivity, visual acuity and intraocular pressure. No Nigerian study exists on changes in intraocular pressure in pregnant women.

Methods

This study was a longitudinal one. One hundred and seventeen pregnant women in their first trimester of pregnancy were followed longitudinally throughout the course of pregnancy, and six weeks post partum. The

women were recruited between the eight and tenth weeks of pregnancy.

The 117 pregnant women were recruited at the antenatal clinic of the Department of Obstetrics and Gynaecology of the University of Benin Teaching Hospital (UBTH). Ethical approval was obtained from the ethics committee and informed consent from the women. This was obtained by having the women sign a written consent form after the study was explained to them. The women were screened for systemic and ocular diseases and these were used as the exclusion criteria for participation in the study.

After measuring their systolic and diastolic blood pressures, Ophthalmoscopy was done to rule out any posterior segment diseases. Intraocular pressure was measured with the hand-held Kowa applanation tonometer. Examination was done between the hours of 8am to 10am on every anti-natal clinic visit. This was to avoid diurnal variation in IOP.

Test was carried out in the first, second and third trimesters of pregnancy and 6 weeks post partum. However, 17 of the pregnant women were lost to follow up either because they did not attend their post natal clinic appointment or did not bring their babies to UBTH for immunization. Some of them also attended UBTH only for the expert antenatal care and never had the intension of giving birth there, probably because they were from out of town. Postpartum, only 100 women were part of the study. One hundred non pregnant women, also of the same age were recruited and examined for changes in intraocular pressure. The average of the data was computed as mean values.

Sample size determination

The sample size was determined using the Leshe-Kish formula for single proportion¹⁰. This is stated below:

$$n = \frac{z^2 pq}{d^2}$$

where n = desired sample size, z = standard normal deviate corresponding to 95% confidence level, p = vertical transmission rate of intraocular pressure (IOP) i.e 3%, q=1-p and d= degree of accuracy (0.05 or 95%). This gave an approximate value of n= 45.

Data analysis

The data obtained was analyzed with GraphPad InStat (Statistical graphics incorporation, USA). Comparison of data among the different groups was performed with one-way analysis of variance (ANOVA), and test between groups with student's t-test.

Results

There was a fall in Intraocular Pressure across the three trimesters of pregnancy and this was highly statistically significant ($P < 0.0001$). At 6 weeks postpartum, mean Intraocular Pressure rose to 14.2 ± 1.8 mmHg. The difference between the mean values of Intraocular Pressure in the third trimester and 6 weeks postpartum was also statistically significant $P < 0.0001$ (t test, $t = 16.47$ with 2017 degrees of freedom) (Table 1).

For the non pregnant women, mean intraocular pressure was high during the follicular phase, gradually declined towards ovulation and rose again in the luteal phase (Table 2). The difference in mean IOP between pregnant and non pregnant women was statistically significant ($t = 7.97$, $p < 0.05$).

Table 1: Intraocular pressure in pregnancy and postpartum

Statistics	First	Second	Third	Postpartum
Mean IOP (mmHg)	14.7	13.2	11.0	14.2
SD	2.2	2.0	1.3	1.8
SEM	0.24	0.22	0.14	0.19
N	100	100	100	100

SD = standard deviation, SEM = standard error of mean, N = number of subjects

Table 2: Intraocular pressure in non-pregnant women

Statistics	Follicular	Ovulation	Luteal
Mean IOP (mmHg)	16.6	15.0	16.0
SD	1.6	1.7	1.5
SEM	0.23	0.24	0.21
N	100	100	100

SD = standard deviation, SEM = standard error of mean, N = number of subjects

Discussion

The changes in intraocular pressure (IOP) during pregnancy were significant in this study. IOP was found to reduce consistently as the pregnancy advanced, with the lowest pressure in the third trimester. This confirms the ocular hypotensive effect of pregnancy. Six weeks postpartum, the intraocular pressure had risen to near pre pregnant values. The finding that the third trimester of pregnancy has an ocular hypotensive effect is consistent with other studies¹⁷⁻²⁰. Philips and Gore²² reported no significant difference in the ocular hypotensive effect of late pregnancy in normotensive and hypertensive pregnant women. The decreased IOP in the pregnant women would explain why pre-existing

glaucoma improves during pregnancy as reported by previous studies.

The physiological mechanism responsible for the decreased in IOP during pregnancy is not well known. A number of mechanisms have been postulated. One²² stated that the decreased IOP in pregnancy is due to elevated hormonal levels which cause an increase in fluid outflow conductance without altering the rate of fluid entry. However, it is well documented that increased levels of progesterone and oestrogen that occur in pregnancy cause dilation of the vessels of the circulatory system leading to decreased arterial pressure and thus a reduction in aqueous humour production²³.

The effects of relaxin could be another good possibility²². During pregnancy, the release of the hormone relaxin, causes a relaxation of the pelvic ligaments of the mother, so that the sacroiliac joints become relatively limber and the symphysis pubis becomes elastic. These changes make for easier passage of the fetus through the birth canal. Philips and Gore²² suggested that this softening of ligaments in late pregnancy might extend to the ligament of the corneo-scleral envelope to produce reduced corneo-scleral rigidity and therefore cause a fall in IOP. This could explain the reduced intraocular reported in this study. This physiological softening of ligaments extending to the corneoscleral envelope is reported to produce only an apparent fall in intraocular pressure. Evidence has been presented previously to support the view that the concept of corneo-scleral rigidity should be largely, if not completely, replaced by variations in ocular volume or, more accurately, variations in surface area of the corneoscleral envelope. Alternatively, improved uveoscleral outflow, which results from the hormonal changes of late pregnancy, is a more likely explanation for a true fall in pressure²⁴.

Some studies^{7,9,26} have stated that the relative ocular hypotension in late pregnancy is probably not due to reduced episcleral venous pressure. The finding of very similar ocular tension in hypertensive and non-hypertensive groups of third trimester pregnant women by Philip and Gore²², contrasts with the association between vascular hypertension and open-angle glaucoma in elderly patients found in a previous study¹⁴. The discrepancy is probably due to the presumed difference in etiology between the two hypertensions, but difference in age may be important. Many other possible explanations exist²⁴. Further research is needed in this aspect.

There were changes in mean IOP in the non pregnant women. Previous studies²⁴⁻²⁵ had reported increase in IOP between 20th and 22nd day. Some studies^{19,20} reported an increase during the luteal phase of the cycle. While others^{24,25} reported an increase

during follicular and luteal phase. The influence of hormonal fluctuations during the menstrual cycle on IOP is still to be clarified.

In summary, this study showed a gradual, statistically significant fall in intraocular pressure during pregnancy. This ocular hypotension was pronounced in the third trimester. This implies that pregnancy could have beneficial effects on glaucoma. Pregnant women with glaucoma should therefore be managed in conjunction with their eye care Practitioner so as to properly monitor them to see if the state of pregnancy can maintain a normal level of intraocular pressure without the administration of intraocular pressure lowering drug.

Intraocular pressure varied during the different phases of the menstrual cycle. This variation is significant and could help in the screening for glaucoma.

This work is by no means exhaustive or conclusive, as further research is needed in this area of study. Improved understanding of the pathophysiology of ocular disease in pregnancy and the impact of pregnancy on the course of pre-existing ocular disease offers the opportunity for meaningful counselling of women who are pregnant or planning to become pregnant. Also, this study has established baseline data on the pattern of intraocular pressure changes in pregnant and non pregnant Nigerian women.

References

- Buckingham T and Young R. The rise and fall of intraocular pressure: the influence of physiological factors. *Ophthalmic Physiol.* 1986; **6**:95-99.
- Buyon JP. The effect of pregnancy on autoimmune diseases. *J Leukocyte.* 1998; **158**: 5087-5090.
- Carel RS. Association between ocular pressure and certain health parameter. *Br. J Ophthalmol.* 1984; **91**:311-314.
- Carlson KH, McLaren JW, Topper JE, Brubaker RF. Effect of body position on intraocular pressure and aqueous flow. *Investig Ophthalmol & Visual Sci* 1987; **28**:1346-1352.
- Coll MRJ. Comparison of intraocular pressure between normal and ocular hypertensive women during various phases of the menstrual cycle. *Pakmedinet.* 2000; **4**:39-43.
- Cho EY and Moon JI. Intraocular pressure change in the pregnant glaucoma or ocular hypertension patients and normal pregnant women. *Korean J Ophthalmol.* 2004; **45**:1880-1884.
- Gharagozoolo NZ and Brubaker R.F. The correlation between serum progesterone and aqueous dynamics during the menstrual cycle. *Acta Ophthalmol (Copenh).* 1991; **69**(6):791-795.
- Green K, Patricia M, Cullen and Calbert I.P. Aqueous humor turnover and intraocular pressure during menstruation. *Br J Ophthalmol* 1984; **68**:736-740.
- Guttridge MN. Changes in ocular and visual variables during the menstrual cycle. *Ophthal and Physiol Opt.* 2007; **14** (1):38-48.
- Henkin P, Schmidt G and Azar O. Variation of intraocular pressure during pregnancy. *Br.J Ophthalmol.* 1983; **74**: 124-128.
- Horven I and Gjonnaess H. Cornea indentation pulse and intraocular pressure in pregnancy. *Arch .Ophthalmol.* 1984; **91**:92-98.
- Jaén-Díaz J, Cordero-García B, López-De-Castro F, De-Castro-Mesa C, Castilla-López-Madrirdejos F and Berciano-Martínez F. Diurnal Variability of Intraocular Pressure. *Arch Soc Esp Oftalmol.* 2007; **82**: 675-680.
- Johnson SM, Martínez M and Freedman S. Management of glaucoma in pregnancy and lactation. *Surv. Ophthalmol.* 2001; **45**: 449-454.
- Khan-Dawood FS and Dawood MY. Estrogen and Progesterone receptors and hormone levels in human myometrium and placenta in term pregnancy. *Am J Obstet Gynecol.* 2000; **150**:501-505.
- Klein BE, Klein R and Knudtson MD. Intraocular pressure and systemic blood pressure: longitudinal perspective: the Beaver Dam Eye Study. *Br J Ophthalmol.* 2005; **89**(3):284-287.
- Lee AJ, Mitchell P, Rohtchina E, Healey PR. Female reproductive factors and open angle glaucoma: the Blue Mountains Eye Study. *Br J Ophthalmol.* 2003; **87**:1324-1328.
- Liang X, Wang X, Wang Y and Jonas J B. Intraocular Pressure Correlated with Arterial Blood Pressure: The Beijing Eye Study. *Am J Ophthalmol.* 2007; **144** (3): 461-462.
- Marc CB, Bartuccio M, Davis J and Murray I. The pregnant woman. *Review of optometry.* 2005; **4**:185-206.
- O'Leary P, Boyne P, Flett P, Beilby J and James I. Longitudinal assessment of changes in reproductive hormones during normal pregnancy. *Clinical Chem.* 1991; **37**:667-672.
- Omoti AE, Waziri-Erameh JM and Okeigbemen VM. A review of the changes in the ophthalmic and visual system in pregnancy. *Afr. J. Reprod. Health* 2008; **87**:245-247.
- Onakoya AO, Ajuluchukwu JN and Alimi HI. Primary Open Angle Glaucoma and Intraocular Pressure In Patients With Systemic Hypertension. *East Afr Med J.* 2009; **86**:214-217.
- Philips CI and Gore SM. Ocular hypertensive effect of late pregnancy with and without high blood pressure. *Br. J. Ophthalmol.* 1985; **69**:117-119.
- Pilas-Pomykalska M, Luczak M, Czajkowiak J, Wozniak P and Oszukowski P. Changes in intraocular pressure during pregnancy. *Klinika. oczna.* 2004; **106** (2):238-241.
- Prajna P, Sheila RP, Ashwin P, Ramaswamy C and Urban J.A. D'Souza. Variations in intraocular pressure during different phases of menstrual cycle among Indian population. *J Physiol Sci.* 2004; **17**:86-89.
- Qureshi IA. Intraocular pressure: association with menstrual cycle, pregnancy and menopause in apparently healthy women. *Chinese J Physiol.* 1995; **38**(4):229-34.
- Qureshi IA. Intraocular pressure and pregnancy. *Clin. Med. Sci J.* 1997; **12**:6-9.