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RESEARCH ARTICLE

The ocular hypotensive effect of pregnancy

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ABSTRACT

Background: Blindness ranked third (after cancer and heart disease) as people's major fear. Glaucoma is the second leading cause of blindness in the world, according to the World Health Organization. Everyone is at risk for glaucoma from babies to senior citizens. Glaucoma is not curable, and vision lost cannot be regained. With medication and/or surgery, it is possible to halt further loss of vision. Unfortunately, approximately 10% of people with glaucoma who receive proper treatment still experience loss of vision. If glaucoma can be treated with simple hormones that change in pregnancy, it would of great pharmacological development and prevention of morbidity in the world. **Aims and Objectives:** Physiology of pregnancy is mainly concerned with maternal adaptations for the growing fetus. All the organ systems in the body undergo adjustments in pregnancy. The aim and objective of the present study are to determine if the changes in pregnancy effect the intraocular pressure (IOP) and to guide future investigation on the treatment of glaucoma. **Materials and Methods:** A longitudinal study was conducted on 100 pregnant women over 9 months. Their IOPs were measured with Goldmann applanation tonometer. **Results:** The mean IOPs (MIOP) in pregnant women in three trimesters of pregnancy were 16.4 ± 2.4 mmHg, 14.6 ± 2.2 mmHg, and 12.2 ± 1.6 mmHg, respectively. **Conclusion:** The IOP decreased during the three trimesters of pregnancy gradually. It concludes that pregnancy has an ocular hypotensive effect. Hence, if pregnancy has an effect to lower the IOP, more research needs to be done to use the reasons responsible for this in the treatment of glaucoma.

KEY WORDS: Pregnancy; Intraocular Pressure; Placental Progesterone; Placental Estrogen; Glaucoma

INTRODUCTION

To date, knowledge on glaucoma medication, surgery, and expectations of treatment are limited. The need for knowledge on treatment of the leading cause of blindness, which is glaucoma, is the reason for doing this study. Low socioeconomic groups use eye care services less frequently although the prevalence of visual impairment and blindness is higher in these groups. This is responsible for late presentation of glaucoma and visual loss at the time of diagnosis, possibly increasing the risk of becoming blind. Treatment of glaucoma costs around thousands of rupees which make it even more difficult and unapproachable for the low socioeconomic groups. The present study is done to see if the physiological changes in pregnancy could have a hypotensive effect on intraocular pressures (IOPs) so that the reason could be identified and can be used as a cost-effective treatment for glaucoma, especially for the low socioeconomic groups in India.

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Pregnancy causes physiological changes in all maternal organ systems, most return to normal after delivery. Physiological changes, which are entirely normal, include cardiovascular, hematologic, metabolic, renal, gastrointestinal, respiratory, and endocrinal.[1]

The fully functional placenta develops by the end of the third month of pregnancy (12 weeks). The syncytiotrophoblast of placenta serves as an endocrine gland. The hormones secreted by the placenta are human chorionic gonadotropin, human chorionic somatomammotropins, human chorionic thyrotropin, placental progesterone, placental estrogen, and relaxin.[2] Other placental hormones include corticotropin-releasing hormone, endorphins, dynorphins, gonadotropin-releasing hormones, inhibin, leptin, prolactin, and prorenin. Parathyroid hormone is increased which leads to increases of calcium uptake in the gut and reabsorption by the kidney. Adrenal hormones such as cortisol and aldosterone also increase. Human placental lactogen is produced by the placenta and stimulates lipolysis and fatty acid metabolism by the woman, conserving blood glucose for use by the fetus.

The sense of vision, the choicest gift from the almighty to the humans, is a complex function of the two eyes and their central connections. The maintenance of IOP plays a vital role in the physiology of vision. The aqueous humor is a clear watery fluid, filling the anterior chamber (0.25 ml) and the posterior chamber (0.06 ml) of the eyeball. In addition to its role in maintaining a proper IOP, it also plays an important metabolic role by providing substrates and removing metabolites from the avascular cornea and the lens. Aqueous humor is derived from plasma within the capillary network of ciliary processes. The normal aqueous production rate is 2.3 µl/min. Aqueous humor flows from the posterior chamber into the anterior chamber through the pupil against slight physiological resistance. From anterior chamber, the aqueous is drained out by two routes: Trabecular (conventional) outflow and uveoscleral (unconventional) outflow.

IOP is the fluid pressure inside the eye. It refers to the pressure exerted by the intraocular fluids on the coats of the eyeball. The normal IOP varies between 10 and 21 mmHg. The normal level of IOP is essentially maintained by a dynamic equilibrium between formation and outflow of aqueous humor.

Tonometry is the method of eye care professionals use to determine IOP. Most tonometers are calibrated to measure pressure in millimeters of mercury (mmHg). The vitreous humor in the posterior chamber has a relatively fixed volume and thus does not affect IOP regulation.

Glaucoma is not a single disease process but a group of disorders characterized by a progressive optic neuropathy, resulting in a characteristic appearance of the optic disc and specific pattern of irreversible visual field defects that are associated frequently with raised IOP.

Most studies have focused on adverse effects of glaucoma medication, prescribing patterns, adverse health outcomes, and new surgical techniques to treat glaucoma. Addressing the gap of more knowledge on new medications required to treat glaucoma, this longitudinal study was conducted.

The aim of the present study is to determine whether the systemic changes in pregnancy would affect the IOPs, confirming the ocular hypotensive effect of pregnancy, implying beneficial effects in the treatment of glaucoma.

MATERIALS AND METHODS

This longitudinal study on 100 pregnant women of age group 20-25 years was carried out from a period of 6-week gestation, over a period of almost 9 months.

This study was conducted in Katuri Medical College and Hospital with the support of Obstetrics and Gynaecology Department. Informed consent was obtained from all women who participated in this study. Approval was taken from the Ethics Committee of the Institution. All the participants were educated about the method of study and the procedure of measuring the IOP with a tonometer.

All the participants were clinically studied for the presence of any systemic or any ocular diseases. Only, those subjects, who were healthy and without a past history of any kind of ocular diseases, were taken in this study. Anterior segment evaluation with the help of slit lamp and posterior segment evaluation with ophthalmoscope was done to exclude any pre-existing ocular diseases. The participants were enquired if they had any refractive or ocular surgeries done because that might affect the IOP.

IOP was measured with Goldmann applanation tonometer. Local eye drops were instilled in both eyes, and fluorescein stain is applied in both eyes. Then, with the help of applanation tonometer, anesthetized cornea is contacted with a tonometer tip approximately 3.06 mm in diameter, and the force necessary to flatten the cornea is determined. The size of the tonometer tip is deliberate to minimize the impact of the corneal resistance and the surface tension of the tear film. Two semicircles were visible through the Biprism. The tension knob is turned to alter the force applied to the cornea, and the readings of IOP are taken out in mmHg when the internal aspect of the two semicircles is in contact with each other.

The data were collected and analyzed using correlation test.

RESULTS

A gradual, statistically significant fall of IOP during pregnancy was observed. In the first trimester of pregnancy, the mean IOP (MIOP) was 16.4 ± 2.4 mmHg. It gradually decreased in the second trimester to 14.6 ± 2.2 mmHg. In the last trimester, the IOP was 12.2 ± 1.6 mmHg. All these results were statistically significant with $P < 0.001$. This clearly showed us the ocular hypotensive effect of pregnancy. The measurements were analyzed by correlation test. Simple

random selection was done from Obstetrics Outpatient Department. Data is analysed using SPSS software, version 24, and statistical test is applied. Graph is depicted. Correlation test shows statistical significance of $P < 0.001$. Hence, it is showing statistical significance between first and third trimesters in pregnancy ($P < 0.001$) (Table 1).

DISCUSSION

The MIOP was 16.4 ± 2.4, 14.6 ± 2.2, and 12.2 ± 1.6 mmHg in the three trimesters of pregnancy, respectively. It is clearly evident from the data that the IOP gradually decreased as the pregnancy advanced. All these results were statistically significant with a $P < 0.001$. This confirms the ocular hypotensive effect of pregnancy.

A decrease in IOP has been observed during pregnancy. Various underlying mechanisms[3] propose to explain the cause of decrease in IOP during pregnancy, namely, an increase in uveoscleral outflow as a result of hormone levels modification, a decrease in systemic vascular resistance, decrease in episcleral venous pressure, increased tissue elasticity, reduction in the aqueous humor production, and decreased corneoscleral rigidity.

Gotovac et al.[4] in their study on the eye and pregnancy have observed that there is an increase in the uveoscleral outflow as a result of pregnancy and labor. Several investigators have documented lower IOP during pregnancy. During pregnancy, high progesterone and increased aqueous outflow facility could assist in lowering IOP.[5] MacLennan et al.,[6] in their research, on serum relaxin in pregnancy, support the possibility of softening of suspensory ligaments of corneoscleral envelope due to hormone relaxin. Decreased peripheral vascular resistance during pregnancy can facilitate aqueous humor outflow and decrease in episcleral venous pressure.[3] Razeghinejad and Tania Tai,[7] in their study, on pregnancy and glaucoma, have observed that there are both decreased aqueous humor production and increased aqueous humor outflow rates during pregnancy. Guttridge[8] while working on changes in ocular and visual variables during the menstrual cycle has also concluded that physiological factors influence the rise and fall of IOP.

Denis and Touvron[9] in their review of Glaucoma management during pregnancy have confirmed that hormones cause an increase in fluid outflow conductance.

Table 1: IOP in different trimesters of pregnancy (N=100)

Trimester	IOP (mean±SD)
First	16.4±2.4
Second	14.6±2.2
Third	12.2±1.6

SD: Standard deviation, IOP: Intraocular pressure

Hormone replacement therapy with estrogen and progesterone in post-menopausal women was found to be associated with reduced risk of glaucoma.[9] The decrease in IOP can lead to changes in women with pre-existing glaucoma which can improve during this period.[9] Qureshi et al.[10] have concluded in their study that the ocular hypotensive effect of late pregnancy is higher in multigravidae than in primigravidae.

Saylik and Salik[11] have confirmed that not only pregnancy but also a number of fetuses in the uterus affects IOP.

Jaén-Díaz et al.[12] have observed diurnal variability of IOP. Liang et al.[13] in the beijing eye study observed that IOP correlated with arterial blood pressure.

However, there were limitations to this study. Lack of prior research studies on the same topic leads to more of an exploratory research than an explanatory research design. Access was limited as the total number of subjects was only limited to 100 in number as the procedure was moderately invasive. It would have been of greater value if we could actually identify which physiological change was causing the significant decrease in the IOP. Recall bias is important as this study depends on recalling the date of last menstrual period. Further research is needed in correlating the hormone levels and their usage to treat glaucoma.

In this study, the great strength was statistically significant data and the readings that we have obtained. A quick association was found between IOP and advancing pregnancy within a short time frame of 11 months. High participation was encouraging.

CONCLUSION

Based on the information provided in this study, pregnant glaucoma patients should be counseled about the usage of IOP decreasing drugs. More research must be done so as to relieve the agony of glaucoma using simple hormones.

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