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Original Research Article

A Clinical Study of Fundus Changes in Patients with Hypertensive Disorders of Pregnancy (PIH) in a Tertiary Care Centre

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Abstract:

Background: This study was conducted to evaluate and determine the prevalence of retinal changes in hypertensive disorders of pregnancy (PIH), recognize the relationship between retinal changes and the degree of hypertension and proteinuria, quantify the prevalence of retinal alterations in 165 women with PIH-related hypertension diseases, and determine as to whether age, gestational age, parity, blood pressure, proteinuria, serum creatinine, serum uric acid, blood urea, and the severity of the disease are associated with the retinal alterations.

Methods: This was a hospital-based observational study conducted among 165 pregnant females who had been admitted with HDP (PIH) to the Department of Obstetrics and Gynecology and those who had been sent to the Ophthalmology Department at Government General Hospital Srikakulam from March 2021 to August 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Results: When the severity of hypertension and fundus findings were studied and correlated, the data was statistically analysed using Fisher's exact test and the p-value was found to be < 0.001. Fundus changes and the degree of proteinuria are studied and correlated. Data was statistically analysed using the Chi-Square test and the p-value was found to be < 0.001, showing a positive correlation between the two variables. When the results were statistically analysed using the one-way ANOVA test, a significant correlation between blood urea levels, levels of serum uric acid, levels of serum creatinine and the severity of PIH was discovered, with a p-value of 0.001.

Conclusion: The health of the foetus depends on placental circulation. An ophthalmoscopic examination of the mother's fundus may provide a clue to similar microcirculation changes in the placenta and indirectly to the wellbeing of the foetus. These changes serve as a guideline for termination of pregnancy as they may reflect similar ischaemic vascular changes in the placenta.

Keywords: Fundus Changes, Patients, Hypertensive Disorders of Pregnancy (PIH).

Introduction

Pregnancy-related hypertensive disorders (PIH) can have serious effects on both the mother and the foetus. Hypertensive disorders are responsible for maternal deaths and substantial morbidity in pregnant women. [1,2] In most cases of hypertensive disorders during pregnancy, the eyes are involved (PIH). Pregnancy can affect anywhere in the visual pathway, from the anterior segment to the visual cortex. Ocular involvement includes conjunctival vascular anomalies, hypertensive retinopathy,[3,4,5] exudative retinal detachment,[6] vitreous and preretinal haemorrhage, ischemic optic neuropathy[7] and hypertensive choroidopathy. Babies are also in danger from hypertensive diseases. Pre-eclampsia is strongly associated with FGR (Fetal Growth Restriction), LBW (Low Birth Weight), spontaneous or iatrogenic preterm delivery, RDS (Respiratory Distress Syndrome), admission to neonatal intensive care and cerebral palsy.[8] With between 7% and 15% of all gestations affected and contributing to around a quarter of all prenatal admissions, hypertensive

disorders are the most frequent medical problem associated with pregnancy.[9] According to the WHO, hypertensive disease remains a leading cause of direct maternal mortality.

The fatal trio that increases morbidity and death during pregnancy and childbirth includes haemorrhage, infection, and hypertension. In wealthy nations, hypertensive diseases were responsible for roughly 16% of maternal deaths, and more than half of these could have been avoided.[10] Maternal mortality is much lower in high-income countries than in developing countries.[11] Pre-eclampsia contributes significantly to the overall preterm birth rate, both spontaneously and iatrogenically. 8-10% of all preterm births result from hypertensive disorders. According to a UK survey on perinatal mortality, pre-eclamptic women gave birth to 1 in 20 (5%) stillborn children who had no congenital abnormalities.[12]The prevalence of retinopathy in patients with hypertensive disorders during pregnancy was examined in several Asian studies, and the findings ranged from 12 to 59%.[13-17] Data on the severity of this illness is scarce. The most dangerous complication of pregnancy is eclampsia, which is regarded as a consequence of severe preeclampsia. It has overtaken other causes of death, showing how challenging it is to stop eclampsia-related deaths. According to several studies, ocular vascular changes are correlated with the degree of hypertension, and ophthalmic examinations are highly helpful in determining the disease's severity as well as its therapy and prognosis.[18-22] Visual acuity typically returns to normal within a few weeks or months following the onset of symptoms in HDP (PIH),[23] but in a very small number of cases, persistent visual impairment can develop. Health care professionals like obstetricians, ophthalmologists, doctors, and neurologists should be aware that the acute development of visual symptoms in pregnant women can be the first indicator of preeclampsia because visual alterations are a diagnostic criterion for severe preeclampsia. Some of HDP's ocular consequences, including serous or exudative retinal detachment and chorioretinopathy, are sight-threatening and can result in blindness, even though the majority of retinal abnormalities in HDP resolve spontaneously after delivery without sequelae.

Obstetricians should be aware of the significance of these changes and talk with the ophthalmologist about the best diagnostic and therapeutic options. The majority of cases are temporary, so affected women should rest confidently. Patients with severe retinopathy need to be monitored over time.

Early antenatal bookings should be encouraged so that hypertensive disorders of pregnancy can be diagnosed and managed early, thus delaying the progression to severe hypertensive retinopathy and its complications.

Aims and Objectives

- To determine the prevalence of retinal changes in hypertensive disorders of pregnancy (PIH)
- To recognize the relationship between retinal changes and the degree of hypertension and proteinuria.
- To quantify the prevalence of retinal alterations in 165 women with PIH-related hypertension diseases.
- To determine whether age, gestational age, parity, blood pressure, proteinuria, serum creatinine, serum uric acid, blood urea, and the severity of the disease are associated with the retinal alterations.

Materials & Methods

This was a hospital-based observational study conducted among 165 pregnant females who had been admitted with HDP (PIH) to the Department of Obstetrics and Gynecology and those who had been sent to the Ophthalmology Department at Government General Hospital Srikakulam from March 2021 to August 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Statistical Methods

Results were statistically analysed using the Chi-square test, Fisher's exact test and one-way ANOVA test. In these tests, a p-value of <0.01 was regarded as statistically significant.

Results

Table 1: Correlating Fundus Findings with Severity of Hypertension

Fundus Finding	Type of HDP (PIH)							
	Mild HTN (DBP < 100)		Severe HTN (DBP ≥ 100)		Eclampsia		Total	
	N	%	N	%	N	%	N	%
Normal	60	65.21	14	27.45	0	0	74	44.84
Gr 1 HTN R	32	34.78	27	52.94	11	50	70	42.42
Gr 2 HTN R	0	0	6	11.76	6	27.27	12	7.27
Gr 3 HTN R	0	0	2	3.92	2	9.09	4	2.42
Gr 4 HTN R	0	0	0	0	1	4.54	1	0.60
ME	0	0	1	1.96	2	9.09	3	1.81
ERD	0	0	1	1.96	0	0	1	0.60

Total	92	100	51	100	22	100	165	100
Fundus Findings		**Types of HDP (PIH)**						
		Mild Preeclampsia		**Severe Preeclampsia**			**Eclampsia**	**Total**
Normal		60		14			0	74
Abnormal		32		37			22	91
Chi-Square Test				P-Value				
Fisher's Exact Test				<0.001				

The severity of hypertension and fundus findings were studied and correlated, the data was statistically analysed using Fisher's exact test, and the p-value was found to be < 0.001, showing the strong positive association between the two variables. This provides the inference that abnormal fundus findings are likely to occur with increasing severity of hypertension.

Table 2: Correlating Fundus Findings with Proteinuria

Fundus Finding	**Proteinuria**									
	1+		**2+**		**3+**		**4+**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Normal	44	65.67	18	42.85	10	26.31	2	11.11	74	44.84
Gr 1 HTN R	23	34.32	21	50	18	47.36	8	44.44	70	42.42
Gr 2 HTN R	0	0	3	7.14	7	18.42	2	11.11	12	7.27
Gr 3 HTN R	0	0	0	0	2	5.26	2	11.11	4	2.42
Gr 4 HTN R	0	0	0	0	0	0	1	5.55	1	0.60
ME	0	0	0	0	1	2.63	2	11.11	3	1.81
ERD	0	0	0	0	0	0	1	5.55	1	0.60
Total	67	100	42	100	38	100	18	100	165	100

Fundus Findings	**Grades of Proteinuria**				
	1+	**2+**	**3+**	**4+**	**Total**
Normal	44	18	10	2	74
Abnormal	23	24	28	16	91
Total	67	42	38	18	165
Chi-Square Test			P-Value		
Fisher's Exact Test			<0.001		

Fundus changes and the degree of proteinuria are studied and correlated. Data was statistically analysed using the Chi-Square test, and the p-value was found to be < 0.001, showing a positive correlation between the two variables. With increasing grades of proteinuria, there are increasing chances of fundus abnormalities.

Table 3: Correlating Severity of HDP (PIH) with Blood Urea Values (mg %)

Severity of PIH	**Minimum**	**Maximum**	**Mean Value**
Mild preeclampsia	19.0	30.0	21.45±2.3
Severe preeclampsia	19.0	30.0	24.07±3.5
Eclampsia	21.0	30.0	26.59±2.7
One way ANOVA test		P-Value <0.001	

Our study's mild preeclampsia group had blood urea levels that ranged from 19 mg/dl to 30 mg/dl, with a mean value of 21.45±2.3mg%. With a mean of 24.07±3.5 mg/dl in the group with severe preeclampsia, it varied from 19 to 30 mg/dl. With a mean value of 26.59±2.7 mg/dl, it varied from 19 to 30 mg/dl in the eclampsia group.
When the results were statistically analysed using the one-way ANOVA test, a significant correlation between blood urea levels and the severity of PIH was discovered, with a p-value of 0.001.

Table 4: Correlating Severity of PIH with Serum Uric Acid Levels (mg/dl)

Severity of PIH	**Minimum**	**Maximum**	**Mean**
Mild Preeclampsia	2.4	6.2	4.096±0.5
Severe Preeclampsia	3.2	6.4	4.901±0.75
Eclampsia	4	6.7	5.4±0.82
One way ANOVA test		P value <0.001	

Patients with mild preeclampsia had serum uric acid levels that ranged from 2.4 to 6.2 mg%, with a mean of 4.09±0.5 mg%. In the group of women with severe preeclampsia, it varied from 3.2 to 6.4 mg%, with a mean of 4.901±0.75 mg/dl. In the eclampsia group, it varied from 4 to 6.7 mg% with a mean of 5.4±0.82 mg%.
When the results were statistically analysed using the one-way ANOVA test, a significant correlation between the levels of serum uric acid and the severity of PIH was discovered, with a p-value of 0.001.

Table 5: Correlating Severity of PIH with Serum Creatinine Levels (mg/dl)

Severity of PIH	Minimum	Maximum	Mean
Mild Preeclampsia	0.5	1	0.591±0.1126
Severe Preeclampsia	0.1	1	0.788±0.1366
Eclampsia	0.6	1	0.891±0.1151
One way ANOVA test		P value <0.001	

Patients with mild preeclampsia had serum creatinine levels that ranged from 0.5 to 1 mg%, with a mean of 0.591±0.1126. It varied from 0.1 to 1 mg% with a mean of 0.788±0.1366 in the severe preeclampsia group. With a mean of 0.891±0.1151, it varied from 0.6 to 1 mg% in the eclampsia group. When the results were statistically analysed using the one-way ANOVA test, a significant correlation between the levels of serum creatinine and the severity of PIH was discovered, with a p-value of 0.001.

Discussion

This study was conducted to evaluate the fundus findings in hypertensive disorders of pregnancy (PIH)

Age Grouping of HDP (PIH)

A total of 165 cases were examined, of which 85 belong to the age group of 21 to 25 years, 39 to the age group of 26 to 30 years, 23 to the age group of 20 years, and the remaining 18 to the age group of 30 years or beyond.

In our investigation, the mean age of the cases was 24.90, which was roughly the same as the ages reported by H.C. Savitha et al.[24] (24), Bharathi NR et al. (23.06), and Muhammad Imran et al.[25] (25.1). Our study's mean age was lower than the mean ages of other studies' 2711, 27.204, 28.26.46, 29.679, and 31.21 years. The mean age of our study was more than 23.26 as found in V.V.L. Narasimha Rao et al.[26] study. Correlating fundus findings according to age group in our study of 165 patients with HDP (PIH), age and fundus findings were compared and analysed statistically with the Chi-square test and Fisher's exact test. The p-value was found to be 0.89417, which is statistically insignificant, and no association was found between these two variables. Similarly, in various other studies, there was no association between age and retinopathy changes.

Parity and HDP (PIH)

In our study, 109 cases (66.06%) were primigravida and the remaining 56 cases (33.93%) were multigravidas. There was no correlation between the increasing number of pregnancies and fundus findings.

According to the literature, nulliparity increases the risk of HDP (PIH).[27] Comparatively, more women (66.06%) in our study are primiparas than in the studies of Ayush Singhal et al. (56.15%) and Reddy et al. (43.5%). While studying 168 patients, Muhammad et al. noted a significant correlation (p = 0.001) between parity and the severity of retinal changes. Shah et al. found that retinopathy was 2.6 times more common in multigravida than primigravida, though the association was not significant.

Similar to our study, in most of the studies conducted by Tania Sadiq et al.[28] Shivangini Kumari et al.[29] and Sujatha Krishnakumar et al.[30] the percentage of primigravidas is higher than the percentage of multigravidas, except for a few studies conducted by H.C. Savitha et al., Khanom R et al., and Reddy SC et al. (2012), where the percentage of multigravidas is higher than primigravidas.

Correlating Fundus Findings with Parity

Similar to our study, in most of the studies, no statistically significant association was found between parity and fundus findings.

Gestational Age and Fundus Change

In our study, there was no statistically significant positive association between gestational age and fundus findings. In a study by H.C. Savitha et al. on 100 patients, it was discovered that 75% of patients had term gestation, 19% had preterm gestation, and 6% had post-dated pregnancy. She analysed the gestational age and fundus changes statistically and found a significant association between the two.

Severity of Hypertension

In our study of 165 patients, 55.75% had mild hypertension, which was more than Reddy et al., Sujatha Krishnakumar et al., Khanom R et al., Tadin et al. study and less than Ayush et al. study. Severe hypertension was reported in 30.90% of cases, which was more than the Tadin et al. study and less than Ayush et al., Reddy et al., Sujatha Krishnakumar et al, Khanom R. et al.

In research by Karki P et al., there were 43 (28.1%) eclamptic patients and 110 (71.9%) pre-eclamptic patients out of 153 PIH patients. Hypertension with seizures was reported in 13.33% of cases, which was more than the Ayush et al., Reddy et al., and Sujatha Krishnakumar et al., studies. Less than Khanom R et al., Tadin et al. study.

Grades of Proteinuria

In our study 67% had Grade 1+, 42 had Grade 2+, 38 had Grade 3+ and 4 patients had Grade 4+ proteinuria, similar to various studies.

Fundus Findings in PIH

In our study, among 165 cases, fundus findings were found in 91 (55.15%) cases. This is comparable to other studies. In their investigation of 40 individuals with PIH, Tadin I. et al. from Croatia found that 45% of fundus alterations had occurred.

In their analysis of 78 patients, S.C. Reddy et al. reported that 59% of fundus alterations had occurred. In a study of 153 cases, Karki et al. from Nepal found that 13.7% of PIH subjects had fundus alterations.

In our study, 52.72% of cases had hypertensive retinopathy. In a retrospective analysis of 148 patients with PIH, Zehra Kurdoglu et al.[31] found that hypertensive retinopathy was prevalent in 48% of cases. 3 (1.81%) cases of macular edema were noted in our study. Similar to the study done by Ayush et al., we found 1 (0.60%) case of exudative retinal detachment in our investigation. Ayush et al. reported 4 (3.1%) cases of exudative retinal detachment in their study of 130 PIH patients.

Hypertensive Retinopathy Grades

39.08% (34) and 45.97% (40) of the participants in our study, respectively, had grade 2 and grade 1 hypertensive retinopathy alterations. Grades 3 and 4 hypertensive retinopathy was found in 11.49% (10) and 3.44% (3) of patients, respectively.

In a study done by Ayush Singal, among 130 PIH patients they reported a prevalence of 57.7%, 2.4% (3), 2.4% (3), and1.5% (2) of grade 1, 2, 3, and 4 hypertensive retinopathy respectively.

Exudative Retinal Detachment

In our study, one case of exudative retinal detachment was found in a 22-year-old primigravida with term gestation and severe preeclampsia with a complaint of defective vision (vision-CFCF counting fingers close to the face), with blood urea of 20 mg/dl, grade 4+ proteinuria. If papilledema, macular edoema, or retinal detachment are present, the pregnancy should be terminated to protect the mother's vision.[32]

J.R. Chandran et al.[33] studies from 2020 reported 4 (2.7%) occurrences of serous retinal detachment (SRD). While platelet levels were lower in those patients, the mean ALT and serum creatinine levels were significantly greater. Retinal detachment had a strong correlation with HELLP (p-value=0.009). In two patients, he also recognised Elschnig's spots.

Macular Oedema

Macular oedema was seen in three instances and is the second most frequent result in our analysis, after hypertensive retinopathy. In research by J.R. Chandran et al. (2020), macular edema was found in 12.7% of cases. A study in 2019 by Khanom R et al. in Dhaka, Bangladesh, on 100 patients with PIH discovered macular edema in 5% of the patients.

Visual Symptoms and Visual Acuity

In our investigation, the majority of the patients were asymptomatic or symptom-free; the most frequent symptoms that were noticed were headaches and vision problems. Scotoma and other symptoms, such as diplopia, were not identified in this investigation.

All patients had normal findings on the anterior segment examination. Visual acuity was found to range between 6/6 and 6/60 in most of the patients. Only 1 patient had worse visual acuity, which is CFCF (Counting Fingers Close to the Face) noted in patients with exudative retinal detachment.

In our study, patients with good visual acuity and asymptomatic patients also had fundus changes on examination. This shows that good visual acuity did not rule out the presence of fundus changes, so it should not be used as a marker of the severity of hypertensive retinopathy or fundus changes.

Rasdi et al. and various studies found that there is no statistically significant association between decreased visual acuity and the severity of hypertensive retinopathy. According to a study by Reddy SC et al.[34] ocular fundus alterations in toxaemia during pregnancy have been linked to temporary blindness in 1% to 3% of eclampsia patients.

Other Retinal Pathologies

Exudates, haemorrhages, peripapillary or focal retinal oedema, exudative or serous retinal detachment, isolated cases of acute ischemic optic neuropathy, transient blindness,[35,36] cortical blindness,[37,38,39] and retinal pigment epithelial lesions[40] are the various changes in the retina and visual system that have been reported in patients with hypertensive disorders of pregnancy from various countries.

The preeclampsia-related ophthalmic conditions cortical blindness, central serous chorioretinopathy, hypertensive optic neuropathy, and vascular occlusions like retinal artery, retinal vein, and retinal or vitreous haemorrhage were not observed in our investigation.

Correlating fundus findings with the severity of hypertension and with grades of proteinuria. The severity of hypertension and fundus results was found to be strongly positively correlated in our

study. In a study of 40 patients with preeclampsia, Tadin et al. from Croatia (2001) observed 45% of retinal changes. Proteinuria, blood pressure, and hypertensive retinopathy were all statistically related, the researchers discovered. Preeclampsia severity and the degree of retinopathy were directly correlated. S.C. Reddy et al. noticed retinopathy in 59% of individuals in their study, the majority of which had grade I hypertensive retinopathy (52.6%), and they found a positive correlation between retinal alterations and blood pressure (p=0.001), proteinuria (p=0.018), and PIH severity (p=0.024). Khanom R et al. (2019) study discovered a relationship between retinal alterations and many factors. Blood pressure and proteinuria both showed a statistically significant positive correlation with the occurrence of retinal abnormalities (P=0.0118 and 0.0025, respectively).

In a study conducted by Rasdi et al. in Malaysia (2011), no statistically significant link was found between retinopathy and patient age, present visual acuity, systolic and diastolic blood pressure.

In research by Reddy et al. (2012) in Malaysia, they looked at 78 individuals and discovered that 59% of them had retinal abnormalities.

Retinal alterations were positively associated with blood pressure (p=0.001), proteinuria (p=0.018), and the severity of PIH (p=0.024) in a statistically significant manner. The degree of PIH and retinal alterations were found to be statistically significantly positively correlated in a study by Kaur et al. (2014). In a 2014 study, 44% of the 100 patients looked at in India by Bhandari and colleagues had retinal abnormalities.

The findings demonstrated a direct correlation between the degree of proteinuria and blood pressure and the severity of retinal abnormalities. Shah et al. examined 150 patients for retinal abnormalities in HDP (PIH) patients as part of a study they carried out in Maharashtra, India.

They discovered 12% prevalence and a statistically significant positive correlation between the severity of PIH, proteinuria, and retinal abnormalities. Correlating the severity of hypertension with blood urea, serum uric acid levels and serum creatinine.

In our study, blood urea levels varied from 19 to 30 mg/dl in mild preeclampsia with a mean value of 21.45±2.39, 19 to 30 mg/dl in severe preeclampsia with a mean value of 24.07±3.59, and 21 to 30 mg/dl in eclampsia with a mean value of 26.59±2.75. The data was statistically analysed with one-way ANOVA test and the results are significant.

Serum uric acid levels in our study ranged from 2.4 to 6.2 mg/dl in moderate preeclampsia, with a mean value of 4.09±0.51; 3.2 to 6.4 mg/dl in severe preeclampsia, with a mean value of 4.90±0.75; and 4 to 6.7 mg/dl in eclampsia, with a mean value of 5.40±0.82. The data were statistically analysed with a one-way ANOVA test and the results are significant.

Blood creatinine levels in our study's patients with mild preeclampsia ranged from 0.5 to 1 mg%, with a mean value of 0.591±0.1126. In the group with severe preeclampsia, it ranged from 0.1 to 1 mg%, with a mean value of 0.788±0.1366. In the eclampsia group, it varied from 0.6 to 1 mg%, with a mean value of 0.891±0.1151.

When the results were statistically analysed using the one-way ANOVA test, a significant correlation between the levels of serum creatinine and the severity of PIH was discovered, with a p-value of 0.001.

Sharma JC et al.[41] (2020) found that all patients with abnormal kidney function tests also had retinopathy to some extent. 62.9% of the cases of thrombocytopenia that were examined also had retinopathy. According to Kishore et al.,[42] when retinopathy progresses, biochemical indicators, including blood urea and serum creatinine deteriorates.

Serum creatinine levels ranged from 0.1 to 1.2 mg/dl in research by H. C. Savitha et al. The mean serum creatinine value was 1.067±0.12 in individuals with fundal abnormalities, with a p-value of 0.001 indicating statistical significance. In her she also noted that serum uric acid was increased in patients with fundal changes, with a mean value of 6.59±1.33, and a p-value of 0.003 which was statistically significant.

Conclusion

A straightforward, non-invasive, secure, and reliable procedure to interpret the vascular changes is the fundus examination of the retina using slit lamp biomicroscopy with +78D or +90D lenses, direct ophthalmoscopy, or indirect ophthalmoscopy with a 20D lens. This is especially true for hypertensive disorders of pregnancy or pregnancy-induced hypertension. Fundus examination in hypertensive disorders of pregnancy is required in all cases of PIH because the retinal vascular abnormalities that are a hallmark of these conditions progress in severity with severe preeclampsia or eclampsia. In HDP (PIH), the fundus examination is crucial for handling and monitoring patients because it indicates the severity of changes in placental microcirculation and corresponds with their severity, which can be used to predict foetal outcomes and ocular morbidity. The advancement of retinal vascular abnormalities was regarded in our study, as in many others, as an indication of growing PIH severity, and they were linked to both maternal and foetal outcomes. Since the health of the foetus depends on placental circulation, an ophthalmoscopic examination of the

mother's fundus may provide a clue to similar microcirculation changes in the placenta and indirectly to the wellbeing of the foetus. These changes serve as a guideline for termination of pregnancy as they may reflect similar ischaemic vascular changes in the placenta.

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