ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr597

Prevalence and Significance of Fundus Assessment in Pregnancy Induced Hypertension: A Cross-Sectional Study

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Publication Date: 2025/04/22

Abstract: Aim: To determine the prevalence of retinal changes in pregnancy-induced Hypertension (PIH) and their association with retinal changes and blood pressure (BP), proteinuria, and disease severity. Methods: A cross-sectional observational study of individuals with PIH was conducted from October 2023 to Jan 2024. Age, gravida, BP, and proteinuria were recorded. Both Anterior segment and fundus examinations were performed. Results: This study included one hundred three patients (21-45 years) with PIH. The gestation period ranged from 25-41 weeks: 43.7% were primigravida, 38.8% had pre-eclampsia, 59.2% had severe pre-eclampsia, and 1.9% had eclampsia. Hypertensive Retinopathy (HTR) changes were seen in 67.9%, with Grade 1 changes in 59.2% and Grade 2 in 8.7%. In our study 35(33.9%) had BP <150/100 mm hg of which 02 (5.71%) had grade 1 HTR, 7 (6.7%) had BP <160/110 mm hg and all of them (100%) had Grade 1 HTR and those with BP >160/110mmhg were 61(59.22%), of which 52 (85.23%) showed grade 1 HTR and 09 (14.8%) Grade 2 HTR. Statistically significant positive associations were found between retinal changes and BP (P=0.000), proteinuria (P=0.000), and severity of the PIH (P=0.000). Conclusion: Retinal changes (grade I and II HTR) were present in 67.96% of patients with PIH, with significant association with blood pressure, proteinuria and severity of the disease. fundoscopic examination proves to be an essential clinical tool in evaluating and managing PIH. Fundus examination serves as an essential tool for assessing the severity of PIH.

Keywords: *Eclampsia, Hypertension, Pregnancy-Induced, Pre-Eclampsia, Prevalence, Retinal Diseases.*

How to Cite: Dr. Vedanshi Joshi; Dr. Tharini Senthamizh; Dr. Ganapathi Kalaiselvi; Dr. Sridhar Baratan (2025) Prevalence and Significance of Fundus Assessment in Pregnancy Induced Hypertension: A Cross-Sectional Study. *International Journal of Innovative Science and Research Technology*, 10(4), 932-936.
https://doi.org/10.38124/ijisrt/25apr597

I. INTRODUCTION

Pregnancy-induced Hypertension (PIH) refers to Hypertension occurring after 24 weeks of pregnancy, characterized by elevated blood pressure >140/90 mmhg, proteinuria in the absence of other causes of Hypertension. If significant proteinuria is present, it is termed pre-eclampsia; when seizures or coma occur due to PIH, it is termed eclampsia. [1] The pathological changes are related to vascular endothelial dysfunction and their consequences, which include vasospasm and capillary leak.[2] The retinal vascular changes generally, correlate with the severity of systemic Hypertension, but not always, and the Retinal vessels rapidly return to normal after delivery, because vaso-spastic manifestations are reversible.

II. SUBJECTS AND METHODS

This study was cross-sectional, observational, which was conducted after the approval of the ethical committee. It was carried out in accordance with the Helsinki Declaration Principles. The study was conducted over four months (Oct-2023 to Jan 2024). The patients who fulfilled the diagnostic criteria of PIH (>24 weeks of pregnancy, high arterial blood pressure and proteinuria) and were admitted to the obstetric and gynec ward, Hospital Tertiary Care Hospital Pondicherry, were included in this study. Individuals with diabetes, high blood pressure, prior eye conditions, or hazy media were not permitted for fundus examination in the study. A comprehensive medical history was collected, and the anterior segment was assessed using a torchlight, and the anterior segment was examined. After dilating both pupils with 1% plain tropicamide.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr597

Fundus was examined with Indirect ophthalmoscope by ophthalmologist. HTR changes seen in one eye or both eyes were considered as a positive finding in that patient. Patient detailed history like Age, race, para, gravida, blood pressure, and proteinuria were collected from the medical records.

The hypertensive retinopathy changes were classified according to Keith Wagener's classification into Grade I as generalized arterial attenuation, especially narrowing of small vessels; Grade II represented a more severe form of Grade I with focal arteriolar narrowing; Grade III included Grade II along with the presence of hemorrhages, hard exudates, and cotton wool spots; and Grade IV defined as Grade III features along with swelling of the optic disc (papilledema). [3,4].

The severity of pregnancy-induced hypertension (PIH) was categorized as follows: - When blood pressure greater than 140/90 mmHg associated with 1+ proteinuria and mild leg oedema, it was defined as Mild pre-eclampsia. When blood pressure was more than 160/110 mmHg, accompanied with 2+ or 3+ proteinuria, and symptoms such as headache, visual or neurological disturbances, epigastric pain, impaired liver function tests, elevated serum creatinine levels considered as Severe pre-eclampsia. Eclampsia was defined as severe pre-eclampsia which was associated with convulsions. Proteinuria was classified as 1+ (0.3 g/L), 2+ (1 g/L), and 3+ (3 g/L) by using dipstick method. [5,6,7].

The results were calculated by using SPSS version 24. To evaluate the relationship between retinal changes and factors such as blood pressure, proteinuria, and the severity of pregnancy-induced hypertension (PIH), the chi-square test was utilized. A P value of less than 0.05 was considered statistically significant.

III. Results

103 patients were enrolled in this study. The average age of patients ranges between 21 to 45 years. Which was 30.2±6.2 years. The gestation duration ranged between 25 and 41 weeks. 45(43.68%) patients were considered as primi gravida. Which was defined as first time pregnant, 57 (55.33%) patients were considered as multigravida. Which was defined as 2 to 4 pregnancies, 1 (0.97%) was grand multi gravida. Which was defined as 5 or more pregnancies. Out of all patients 40 (38.83%) patients were considered as mild pre-eclampsia, 61(59.22%) had severe pre-eclampsia, and 2 (1.941) had eclampsia. Retinopathy changes were seen in 67.9%, with Grade 1 changes in 59.2% (61) and Grade 2 in 8.7%. (Fig 1) In our study 35(33.9%) had BP <150/100 mm hg of which 02 (5.71%) had grade 1 HTR, 7 (6.7%) had BP <160/110 mm hg and all of them (100%) had Grade 1 HTR and those with BP >160/110mmhg were 61(59.22%), of which 52 (85.23%) showed grade 1 HTR and 09 (14.8%) Grade 2 HTR. Statistically significant positive associations between retinal changes and BP were noted in our study (P=0.000) (Table 1).

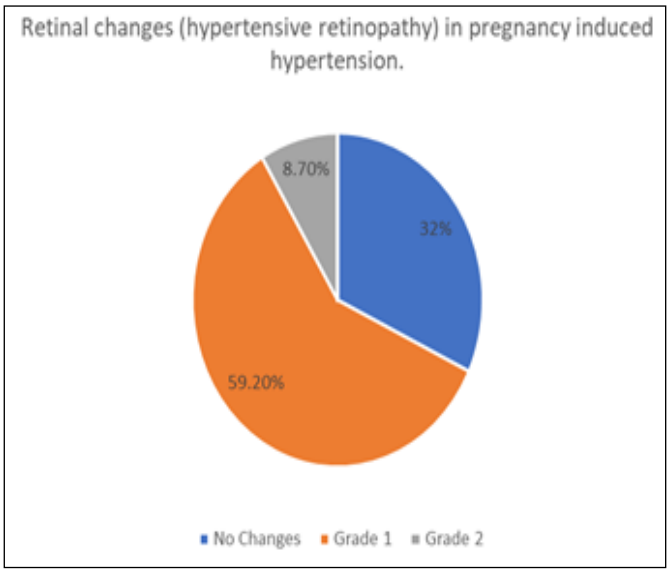

Fig 1: - Distribution of Retinal changes in PIH

Table 1: - Association of Retinopathy with Hypertension

		Blood Pressure				
		Systolic<150 Diastolic<100	Systolic<160 Diastolic<110	Systolic>160 Diastolic>110	Total	p value
Grades of Retinopathy	0	33	0	00	33	0.000
	1	02	07	52	61	
	2	00	00	09	09	
Total		35	07	61	103	

In our study we found that out of 31(30.09%) patients with 1+ proteinuria 05 (16.12%) had Grade 1 hypertensive changes, 2+ proteinuria was present in 53 (51.45%) of which 52(98.11%) had Grade 1 HTR, +3 proteinuria 10 (9.70%) had HTR changes. Proteinuria +3 had more % of Grade 2 HTR changes compared to proteinuria +1 and +2. We found positive associations between retinal changes and proteinuria (P=0.000) and it was statistically significant. (Table 2)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr597

Table 2: - Association of Retinopathy with Proteinuria: -

		Proteinuria					
		+	++	+++	Nil	Total	p value
Grades of Retinopathy	0	26	00	00	07	33	0.000
	1	05	52	02	02	61	
	2	00	01	08	00	09	
Total		31	53	10	09	103	

In our study we found that out of 40 (38.83%) of mild pre-eclampsia patient 07 (6.8%) had grade 1 HTR. Out of 61(59.2) of Severe pre-eclampsia 53(86.88%) had grade 1 HTR and 08 (13.11) had Grade 2 HTR. Out of 02 (1.94%) of Eclampsia 01(50%) had Grade 1 HTR and 01(50%) had Grade 2 HTR. The severity of Grades of HTR increased in Eclampsia than mild pre-eclampsia patient. In this study there were statistically significant positive associations found between retinal changes and severity of PIH (P=0.000). (Table 3)

Table 3: - Association of Retinopathy with Severity of Disease.

		Severity of disease				
		Mild pre-eclampsia	**Severe pre-eclampsia**	**Eclampsia**	**Total**	**p value**
Grades of Retinopathy	0	33	00	00	33	0.000
	1	07	53	01	61	
	2	00	08	01	09	
Total		40	61	02	103	

In our study 65 (42.71%) patients belong to age between 21 to 30 years, 37 (36%) patients belong to age between 31 to 40 years. and 1(1%) of age group more than 40 years had retinopathy changes. In this study there were no any significant association was found between retinal changes and age (P=0.592). (Table 4)

Table 4: - Association of Retinopathy with Age.

		Age				
		21-30 years	**31-40 years**	**>40 years**	**Total**	**p value**
Grades of Retinopathy	0	21	12	0	33	0.5923
	1	40	20	1	61	
	2	4	5	0	09	
Total		65	37	1	103	

In our study 33 (32%) of primi, 57 (55.33%) >=2-5 gravida, 01(1%) >5 gravida had retinopathy changes. In this study there were no any significant association was found between retinal changes and gravida (P=0.511). (Table 5)

Table 5: - Association of Retinopathy with Gravida.

		Gravida				
		Primi	**>=2-5**	**>5**	**Total**	**p value**
Grades of Retinopathy	0	12	21	0	33	0.5113
	1	31	29	1	61	
	2	2	7	0	9	
Total		45	57	01	103	

IV. DISCUSSION

In this study, hypertensive retinopathy changes grade I and II were observed in 67.96% of patients who had pregnancy-induced Hypertension. There were no any evidence of Hemorrhages, exudates, and retinal detachment in any of the patients. Due to advance antenatal check-up and antenatal visit of pregnant woman, hypertension was diagnosed in early periods of pregnancy and for which treatment was started immediately. Research conducted by Jaffe and Schatz and their colleagues in the United States demonstrated a significant relationship between pre-eclampsia severity and specific retinal vascular changes, particularly the diminished arteriole-to-vein ratio and increased frequency of focal arteriolar narrowing.[8] They did not find any hemorrhages, exudates, cotton wool spots, or retinal detachment in their study of 17 mild preeclamptic and 14 severe preeclamptic patients. In a study of 275 cases of pre-eclampsia and 125 cases of eclampsia, in their comprehensive analysis of 400 cases, Reddy and colleagues documented retinal changes in 53.4% of individuals with pre-eclampsia and a substantially higher rate of 71.2% among those with eclampsia, yielding an overall prevalence of 59% (236 patients) across both conditions. Among the documented retinal findings in their research, vascular constriction of the arteriolar vessels represented the most frequently observed abnormality, occurring in approximately 45.7% of participants (corresponding to 183 individuals

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr597

within the 400-patient study population). Additionally, Reddy's investigation established that retinal changes demonstrated a statistically significant increase in both frequency and intensity among subjects who presented with more elevated blood pressure. [9] Pregnancy-induced Hypertension (PIH) is notably higher than previously reported rates of 13.7% by Karki et al., 21.5% by Rasdi et al., and 45% by Tadin et al. [10,11,12] Our findings align more closely with Reddy's observation of 59% retinal changes in their study of 400 cases. This variation in prevalence rates could be attributed to differences in study populations, timing of examination, and criteria used for diagnosis. Our investigation yielded a particularly noteworthy observation: the exclusive detection of mild retinopathy manifestations—specifically Grade I (observed in 59.2% of cases) and Grade II modifications (identified in 8.7% of subjects)—In retinal findings retinal hemorrhages, exudative lesions, and cotton wool spots were entirely absent from our patient population. The absence of advanced retinal pathology in our cohort corresponds with the ophthalmologic observations documented by Jaffe and Schatz in their research, wherein they similarly identified no severe-grade funduscopic abnormalities despite examining patients across the spectrum of preeclampsia severity, from mild presentations to more critical cases.The absence of severe retinal manifestations in our cohort may be attributed to early detection and prompt management of PIH through improved antenatal care services and systematic screening protocols, which enable timely intervention and better blood pressure control in the study population. Statistical analysis of our collected data demonstrated robust correlations of high significance between funduscopic abnormalities and multiple clinical parameters, including measured arterial blood pressure values (P=0.000), proteinuria (P=0.000), and severity of disease (P=0.000). These correlations support the utility of fundoscopic examination as a predictive tool in PIH management. Our results were concurrent with the association found in previous studies.[13] Notably, age (P=0.592) and gravida (P=0.511) showed no significant association with retinopathy development, suggesting that disease severity rather than demographic factors primarily influence retinal changes.

The prevalence of hypertensive retinopathy changes (67.96%) observed in our study is higher than the rates reported in other studies, such as 13.7%, 21.5%, and 45 %, but similar to the 59% prevalence reported in similar literature [9,10,11,12,14]. Our investigation's finding regarding the absence of exudative lesions and hemorrhagic manifestations in the retinal examination observations previously reported in the research conducted by Jaffe and Schatz. [8]. The microcirculation of the retina offers a unique opportunity to directly visualize vascular structures that share important developmental and functional characteristics with the placental vasculature. Both retinal and placental circulations are end-arterial systems with highly specialized functions that support metabolically demanding tissues. This parallel makes retinal examination a potentially valuable window into placental health.

When examining pregnant women, changes in retinal arterioles—such as narrowing, irregularity, arteriovenous nicking, and increased vascular tortuosity—may mirror similar microvascular alterations occurring within the placenta. These changes can be particularly significant in conditions such as preeclampsia, gestational hypertension, and diabetes mellitus, where widespread endothelial dysfunction affects multiple vascular beds throughout the body. Retinal hemorrhages observed during ophthalmoscopic examination may indicate increased vascular fragility or permeability that could be simultaneously occurring in the placental circulation. Since the placenta serves as the lifeline for fetal nutrition, oxygenation, and waste removal, compromised placental circulation directly impacts fetal development and well-being. Ophthalmoscopic examination makes it an attractive screening tool during pregnancy. By visualizing the fundus, clinicians may detect early signs of vascular pathology before clinical manifestations of placental insufficiency become apparent. This early detection could potentially allow for timely interventions to improve maternal-fetal outcomes. Current research suggests that quantitative analysis of retinal vascular parameters, including vessel caliber, branching patterns, and fractal dimensions, may provide objective measures that correlate with placental perfusion and, by extension, fetal health. Advanced imaging techniques such as optical coherence tomography angiography further enhance our ability to assess retinal microvasculature with unprecedented detail. As our understanding of the relationship between retinal and placental vasculature continues to evolve, ophthalmoscopic examination may become an increasingly valuable component of comprehensive prenatal care, offering insights into the invisible world of placental circulation and its critical role in supporting fetal well-being. [15].

V. CONCLUSION

The findings support the integration of ophthalmological examination as a standard component of PIH management protocols. This approach could improve maternal and fetal outcomes through improved risk stratification and timely intervention.

In conclusion, fundoscopic examination proves to be an essential clinical tool in evaluating and managing PIH. Its role in predicting disease severity and monitoring progression warrants its inclusion in routine antenatal care protocols for PIH patients. Further research is recommended to establish standardized guidelines for the frequency and timing of fundoscopic examinations in this patient population.

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