

One Year Cross-sectional Study of Fundal Changes in Patients with Pregnancy-Induced Hypertension

Pathak Neha^{1*}, Singh Jaishree², Meena Ashok K³, Gupta Tarun⁴, Jain Mukul¹

¹MS Ophthalmology, ²Professor & Head, ³Professor, ⁴PG Resident (3rd year),
Department of Ophthalmology, Government Medical College, Kota, Rajasthan, India.

ABSTRACT

Introduction: A retinal fundoscopic examination by detecting retinal arteriolar spasm might aid in determining whether immediate delivery of the baby is required to revert the preeclamptic state and prevent an adverse maternal and foetal outcome. The focus of the current study is to find out the frequency and spectrum of fundal changes in 100 cases of PIH and to deduce any association between the retinal changes and blood pressure, proteinuria, severity of PIH, maternal age, gravidity and gestational age, so that we could engineer a more efficient and systematic approach towards PIH to ensure maternal and fetal well-being.

Aims: 1) To evaluate the frequency and spectrum of retinal fundus changes in Pregnancy-Induced Hypertension

2) To assess relationship of hypertensive retinopathy with maternal gravidity, severity of PIH and blood pressure in PIH.

Methodology: Hundred patients with PIH were studied in a one year, cross-sectional, hospital-based study. Detailed ocular examination was done and results were analyzed. Chi-Square, ANOVA and Student T-test were used for statistical analysis. $P \leq 0.05$ was considered significant.

Results: 44% of patients were primigravida and 59% had gestational age > 32 weeks. 53% had severe preeclampsia and 14% had eclampsia. Grade I hypertensive retinopathy was found in 53% patients. Occurrence of retinopathy was significantly higher in primigravida group (84%) and patients with both systolic and diastolic hypertension (84.44%).

Conclusions: This study shows that with increasing severity of PIH, chances of development of more severe grade of retinopathy increase. Frequency of occurrence of retinopathy is higher in primigravidae and in patients having both systolic and diastolic hypertension. Mean systolic and diastolic blood pressure values in patients with retinopathy are significantly higher than those in patients without retinopathy. Mean blood urea and serum uric acid values increase significantly as the severity of PIH increases.

Key-words: PIH, Hypertensive Retinopathy, Proteinuria, Blood Urea, Serum Uric acid.

*Correspondence to:

Dr. Neha Pathak,
E-251, Udai Path, Shyam Nagar,
Sodala, Ajmer Road, Jaipur, Rajasthan, India.

Article History:

Received: 29-11-2016, **Revised:** 10-01-2017, **Accepted:** 28-02-2017

Access this article online

Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2017.3.2.013	

INTRODUCTION

Pregnancy induced hypertension (PIH) which includes preeclampsia and eclampsia occurs in approximately 5% of pregnancies usually after 20th week of pregnancy.¹ The incidence of preeclampsia ranges from 5-10% and eclampsia affects 5%, leading to 17.2% of maternal mortality and 22% of fetal mortality. Early detection and treatment are therefore of paramount importance.²

This systemic disease which can affect almost every organ system of the body, has potentially devastating consequences for both mother and baby.³ Since there exists a close relationship between retinal, cerebral and renal vessels, funduscopy gives the opportunity of observing the changes in the vascular tree and deducing therefrom, the general condition of vascular system of the body.

Retinopathy in toxemia of pregnancy occurs late in pregnancy (practically always in the ninth month). It has many of the characteristics of hypertensive retinopathy. Fundoscopic findings include a reduced arteriole to vein ratio, A-V crossing changes, hemorrhages, retinal exudates, cotton-wool spots, exudative retinal detachments and choroidal infarcts.⁴

In general, it is believed that the presence of changes in the retinal arterioles and retinal hemorrhages may indicate similar changes in the placenta. Since the well-being of the fetus depends on the placental circulation, ophthalmoscopic examination of mother's fundus may give a clue to similar micro-circulation changes in the placenta and indirectly to the fetal wellbeing. Fundus examination in patients with PIH is an important clinical evaluation to predict adverse fetal outcome.⁵

Thus the retinal fundoscopic examination has become the primary investigative procedure in assessment of patients with PIH. The procedure is simple, non-invasive, cost effective and easily performed either at outpatient department or at bedside. Ocular changes may be the initial finding in an asymptomatic patient, necessitating primary care referral.⁶

The focus of the current study is to evaluate the frequency and spectrum of retinal fundus changes in PIH and to assess relationship of hypertensive retinopathy with maternal gravidity, severity of PIH, blood pressure and proteinuria in 100 cases of PIH.

SUBJECTS AND METHODS

One hundred consecutive patients who were referred to Department of Ophthalmology, diagnosed as having PIH from January 2014 to December 2014 were included in the study.

Exclusion Criteria

- Positive history of hypertension, diabetes mellitus, cardiovascular disease and collagen vascular disease prior to pregnancy.
- Ocular media opacity in both eyes which might interfere with detailed examination of fundus was excluded from the study.

All the patients included were informed in detail about the procedure and an informed consent was taken. Age, gravida, gestation period, blood pressure (at the time of admission), and severity of proteinuria were noted from the case records. After obtaining history and presenting complaints, patient was examined for pallor, pedal edema, pulse and blood pressure (at the time of fundus examination). Patients' visual acuity was checked clinically at bed side. Torch light examination was done to rule out any gross anterior segment pathology. One to two drops of 0.5% of tropicamide were instilled into the cul-de-sac. The patient was instructed to apply digital pressure on lacrimal sac for 2 to 3 min after drug instillation to avoid systemic absorption. 15 to 20 minutes later, fundoscopy was done by an experienced ophthalmologist and the postgraduate student. Initial examination was carried out with direct ophthalmoscope followed by indirect ophthalmoscopy. The fundus picture was described and documented with the help of color coded fundus diagrams. Patients who were stable were mobilized to ophthalmic department and fundus photographs were taken with the help of fundus camera. The ophthalmoscopic findings were documented and staging and grading was done according to Keith Wagener's classification of Hypertensive retinopathy.^{7,8} as below:

Grade 1:

Mild-to-moderate narrowing or sclerosis of the arterioles

Grade 2:

Moderate to marked narrowing of the retinal arterioles

Exaggeration of the light reflex

Changes at arterio-venous crossings.

Grade 3:

Retinal arteriolar narrowing and focal constriction

Prominent arterio-venous crossing changes

Retinal edema

Cotton-wool patches

Flame-shaped hemorrhages

Grade 4:

As for Grade 3, plus papilloedema

After doing staging and grading as per Keith Wagener's classification of Hypertensive Retinopathy, diagnosis of retinopathy was made and further obstetric management was decided based on fundoscopic findings.

The severity of PIH was classified into preeclampsia (mild and severe) and eclampsia, based on the following findings:

Mild preeclampsia: BP >140/90mmHg, proteinuria +, and/or mild edema of legs;

Severe preeclampsia: BP ≥160/110mmHg, proteinuria ++ or +++, headache, cerebral or visual disturbances, epigastric pain, impaired liver function tests, and increased serum creatinine;

Eclampsia: Severe preeclampsia + convulsions.

Proteinuria was tested using dipstix method and was graded as + = 0.3gm/L, ++ = 1gm/L, and +++ = 3gm/L.

Chi-Square, ANOVA and Student-t test were used for statistical analysis. *P* ≤ 0.05 was considered significant.

Table 1: Distribution according to Gravida

Gravidity	No. Of Patients
G1	44 (44%)
G2	36 (36%)
G3	14 (14%)
G4	1 (1%)
G5	2 (2%)
G6	2 (2%)
G8	1 (1%)
TOTAL	100 (100%)

Table 2: Distribution according to Severity of PIH

Severity Of PIH	No. Of Patients
Mild Pre-Eclampsia	33 (33%)
Severe Pre-Eclampsia	53 (53%)
Eclampsia	14 (14%)
TOTAL	100 (100%)

Table 3: Distribution of fundus changes according to Grades of Retinopathy

Grade Of Retinopathy	No. Of Patients
Normal Fundus	29 (29%)
Grade I hypertensive retinopathy	53 (53%)
Grade II hypertensive retinopathy	3 (3%)
Grade III hypertensive retinopathy	10 (10%)
Grade IV hypertensive retinopathy	3 (3%)
Retinal Detachment	2 (2%)
TOTAL	100 (100%)

Table 4: Correlation between Gravidity & Occurrence of Retinopathy

Gravida	No. Of Patients With Retinopathy
Primigravida [44]	37 (84.09%)
Multigravida [56]	34 (60.71%)
TOTAL [100]	71 (71%)

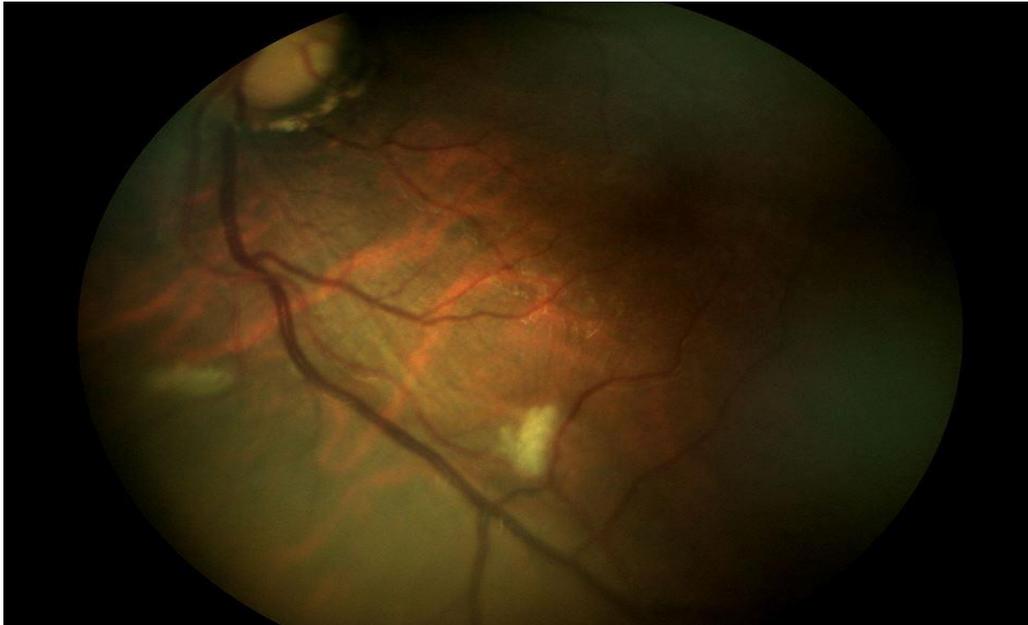


Figure 1: Case no. 21 Sofiya, 22yr old, G1P0A0L0, 28 weeks pregnant, complaint- blurred vision, BP- 200/120 mmHg, Severe PIH; Fundus showed generalized arteriolar narrowing with cotton wool spots in the retina suggestive of Grade III Hypertensive Retinopathy.

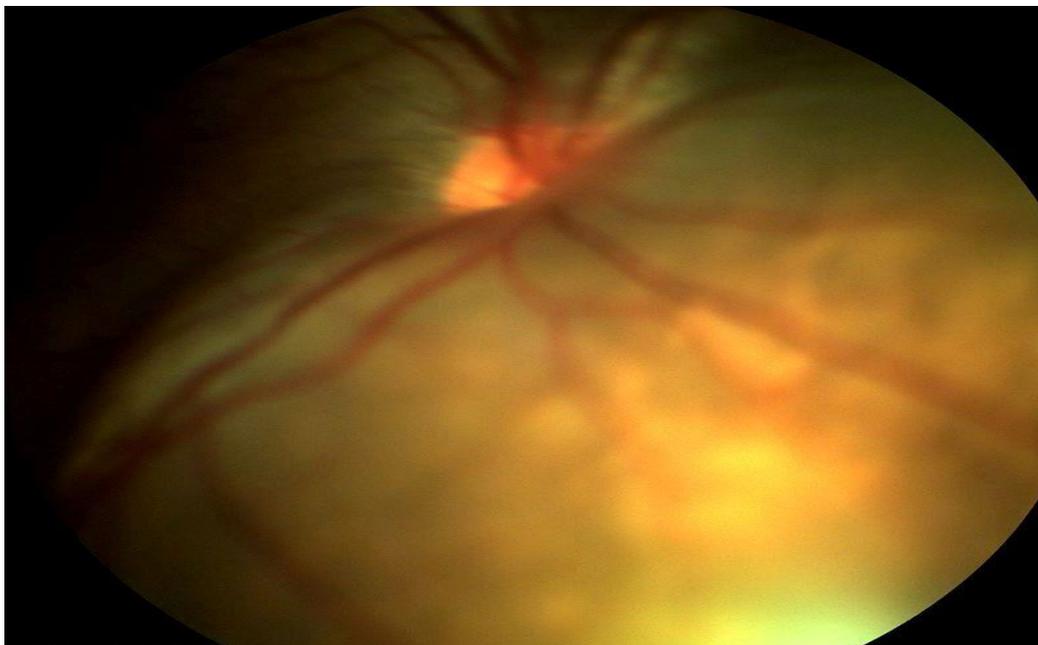


Figure 2: Case no. 74, Sohanlata, 29 yr old, G1P0A0L0, 30 weeks pregnant, complaints- convulsions, anasarca, flashes, black spots, Fundoscopy showed serous retinal detachment (convex configuration, loss of normal choroidal pattern of vessels, moving freely with eye movements, retinal vessels coursing over the folds in detached retina)

Table 5: Association between Type of Hypertension and Occurrence of Retinopathy

BP (mmHg)	No. Of Patients	Retinopathy
Diastolic BP \geq 110	5	1 (20%)
Systolic BP \geq 160	16	12 (75%)
Both	45	38 (84.44%)
TOTAL	66	51 (77.27%)

Table 6: Comparison of Mean Systolic and Diastolic Blood Pressure in Retinopathy and Normal Fundus Groups

RETINOPATHY	MEAN	
	Systolic BP (mmHg)	Diastolic BP (mmHg)
Present	170.79	111.61
Absent	155.52	103.45

Table 7: Correlation between Severity of PIH & Severity of Retinopathy

Grade of Retinopathy	No. of Patients		
	Mild Preeclampsia Group	Severe Preeclampsia Group	Eclampsia Group
Normal	14 (42.42%)	13 (24.53%)	2 (14.29%)
Grade I	17 (51.51%)	28 (52.83%)	8 (57.14%)
Grade II	0 (0%)	3 (5.66%)	0 (0%)
Grade III	1 (3.03%)	7 (13.2%)	2 (14.29%)
Grade IV	1 (3.03%)	2 (3.77%)	0 (0%)
Retinal Detachment	0 (0%)	0 (0%)	2 (14.29%)
TOTAL	33 (100%)	53 (100%)	14 (100%)

Table 8: Correlation between Severity of Proteinuria and Retinopathy

Proteinuria	No. of Patients With Retinopathy
+	40 (59.7%)
++	21 (95.45%)
+++	6 (85.71%)
++++	4 (100%)

Table 9: Correlation between severity of PIH and blood urea value(mg/dl)

Severity of PIH	BLOOD UREA VALUE (mg/dl)		
	Maximum	Minimum	Mean
Mild Pre-eclampsia	53	11	24.24
Severe Pre-eclampsia	53	10	26.67
Eclampsia	98	12	36.86

Table 10: Relationship between uric acid value(mg/dl) & severity of PIH

Severity Of PIH	SERUM URIC ACID LEVEL (mg/dl)		
	Maximum	Minimum	Mean
Mild Pre-eclampsia	8.5	1.8	4.18
Severe Pre-eclampsia	8.3	2.1	4.42
Eclampsia	10	2.2	5.97

RESULTS

A total of 100 patients with Pregnancy Induced Hypertension were enrolled in the study. Of these 100 patients, 71% were in the age group of 20-29 years followed by 28% in the age group of ≥ 30 years. Forty four (44%) of the total patients were primigravida (Table 1). Fifty nine (59%) were in 32-40 weeks of gestation period. Thirty three (33%) had mild preeclampsia; fifty three (53%) had severe preeclampsia while remaining fourteen (14%) patients had eclampsia (Table 2). Fifty three (53%) patients had grade I hypertensive changes while twenty nine (29%) patients had normal fundus with no evidence of any hypertensive changes on funduscopy. Grade II and Grade III (Figure 1) Retinopathy changes were seen in three (3%) and ten (10%) patients respectively. Grade IV Retinopathy was seen in 3 patients- Amreen (21 yr old, G1 P0 A0 L0), Bhuri (30 yr old, G6 P5 A0 L5) and Nandkanwar (23 yr old, G2 P1 A0 L1), all of whom presented near term with blurred vision, pedal edema and slightly elevated Blood Urea, Serum Creatinine and Serum Uric acid values. On funduscopy, Amreen and Nandkanwar were also found to have macular edema while Bhuri had macular star. Vision improved after urgent termination of pregnancy. Exudative retinal

detachment (Figure 2) complicating PIH was seen in two patients (Table 3) – Sohanlata (29 yr old, G1 P0 A0 L0) and Rashidan (36 yr old, G2 P0 A1 L0). Both presented near term with severe hypertension, convulsions, anasarca and visual symptoms like blurred vision, flashes and floaters and grossly derailed biochemical parameters. Visual acuity had worsened to Finger Counts at 1 metre. Termination of pregnancy was ensued by rapid recovery from symptoms and return of normal visual acuity within a week. Occurrence of retinopathy was significantly higher in the primigravida group (Chi-Square Test $p=0.011$) (Table 4). Maternal age and gestational age were non-determinant factors in occurrence of retinopathy ($p=0.953$, $p=0.335$ respectively). Occurrence of retinopathy was most strongly associated with both systolic and diastolic hypertension followed by pure systolic hypertension and pure diastolic hypertension (Table 5) ($p=0.004$). Systolic BP values in the retinopathy group were found to be significantly higher than those in the normal fundus group (Student T-test $p=0.0007$). Difference between the Diastolic BP values in the two groups was also statistically significant (Unpaired T-test $p=0.012$) (Table 6). Most frequent fundal abnormality was arteriolar narrowing (71% cases). Mild generalized arteriolar

narrowing was the most common subtype (41% cases). A statistically significant positive correlation was present between severity of retinopathy and severity of PIH (Chi-Square test; $p=0.018$) (Table 7). All patients had proteinuria of varying severity ranging from 1+ to 4+. A statistically significant positive correlation was observed between severity of proteinuria and retinopathy (Chi-Square test: $p=0.004$) (Table 8). It was also inferred that with increasing severity of PIH, the mean value of biochemical parameters like blood urea (ANOVA test; $p=0.017$) and serum uric acid (ANOVA test; $p=0.002$) also increased significantly (Table 9, 10). These investigations can hence, be of additional advantage in assessing the severity of PIH.

Thus in this study, we tried to evaluate frequency and spectrum of fundal changes in patients with PIH and also the various factors affecting the degree of fundal changes like gravidity, blood pressure, severity of PIH and proteinuria.

DISCUSSION

There is paucity of data available in the published literature on the prevalence of retinal changes in PIH from India. Therefore, this study was undertaken to determine the prevalence and spectrum of fundal changes in 100 cases of PIH. Attempt was also made to deduce any association between the retinal changes and blood pressure, proteinuria, severity PIH, maternal age, gravidity and gestational age, so that we could engineer a more efficient and systematic approach towards PIH to ensure maternal and fetal well-being.

Mean age of the patients in this study was 26.21 years (range 19-45 years). In Tadin et al study of 40 women with pre-eclampsia, 45% (18 patients) showed abnormalities of the fundus. The average age of those 40 patients was 29.1 years.⁹

Pre-eclampsia in an otherwise healthy woman is a disease of first pregnancy.¹⁰ In Reddy et al study, 34 (43.5%) were primigravida, gestational age at presentation ranged between 25 and 41 weeks.¹¹ The results of the present study were in harmony with the previous study as 44 patients (44%) were primigravida and the gestational period at the time of presentation with PIH ranged from 20-43 weeks. The mean gestational age was 32.71 weeks and maximum number of patients (59%) developed PIH after 32 weeks of gestation.

In Reddy et al study of 78 patients, thirty (38.5%) had mild preeclampsia, 46 (59%) had severe preeclampsia and 2 (2.5%) had eclampsia.¹¹ In the present study, 33% patients had mild preeclampsia, 53% had severe preeclampsia and 14% had eclampsia. Severity of PIH was slightly higher in our study as compared to the preceding studies as a major percentage of patients included in the study were illiterate and ignorant to the concept of proper ante-natal care.

As reported in 1952 by Dieckmann WJ, visual symptoms were present in 30-50% of patients with eclampsia and 20-25% of patients with preeclampsia.^{10,12} In the present study, visual symptoms were seen in 70% of the patients with eclampsia and 15% of the patients with preeclampsia. Further the prevalence of visual symptoms (blurred vision, flashes of light and black spots in field of vision) bore a statistically significant correlation with severity of PIH. Beck RW et al in 1980 observed retinal changes to be present in 40-100% patients of preeclampsia.^{10,13} Hallum AV in his study of 300 patients found out that the most common ocular finding is constriction of arterioles occurring in

approximately 60% of patients with preeclampsia.¹⁴ Retinal detachment is seen in 1-2% of all patients with PIH.¹⁵ In the present study, 71% of patients with PIH had retinal involvement. Further, Grade I Hypertensive Retinopathy which consists of retinal arteriolar narrowing was the most frequent finding seen in 53% of the patients followed by 10% patients who had Grade III Retinopathy. Grade II and IV Retinopathy were seen in 3 patients each. Patients who had retinal detachment constituted 2% of the total patients. Lack of awareness in the rural population, who present to the hospital at term without any prior antenatal care, might be the reason behind the greater prevalence of Grade III and IV Retinopathies in our study.

In Reddy et al study¹¹ (2012) and a recent study by Bharathi NR et al¹⁶ (2015), no significant effect of maternal and gestational age was found on the degree of retinopathy. Similarly in the present study, correlation of maternal and gestational age with both occurrence and severity of retinopathy was found out to be statistically non-significant.

Bharathi NR et al in their study found a significant correlation of occurrence of retinopathy in association with primigravidae.¹⁶ Whereas, Reddy et al observed the association of primigravidae with the severity of retinopathy to be statistically non-significant.¹¹ In the present study as well, correlation of primigravidae with occurrence of retinopathy was found to be statistically significant ($p=0.011$) but severity of retinopathy ($p=0.085$) bore no significant association with primigravidae.

The correlation between type of hypertension and retinopathy was studied and it was inferred that prevalence of retinopathy was higher in patients with both systolic and diastolic hypertension (84.44%), as compared to those with pure systolic (75%) or pure diastolic (20%) hypertension ($p=0.004$). The means of Systolic BP and Diastolic BP were significantly higher in patients with retinopathy (Mean SBP= 170.79 mmHg, Mean DBP= 111.61 mmHg) as compared to those without retinopathy (Mean SBP= 155.52 mmHg, Mean DBP= 103.45 mmHg). The mean SBP ($p=0.0007$) and mean DBP ($p=0.012$) values were found to have a statistically significant positive correlation with retinopathy. Bharathi NR et al also obtained similar results in their 2015 study.¹⁶

Reddy,¹⁷ Sheth BP,¹⁸ and Hallum AV¹⁴ in their respective studies found out that the most common ocular finding is constriction of arterioles occurring in approximately 60% of patients with preeclampsia. Wagener reported spastic lesions of retinal arterioles in 70% cases of PIH.¹⁹ Prado RS et al in their 2002 study concluded that retinal detachment is seen in 1-2% of all patients with PIH.¹⁵ The observations in the present study of 100 patients were in harmony with the aforementioned studies as arteriolar narrowing was the most common finding (seen in 71% patients) and serous retinal detachment was seen in 2% cases.

Tadin et al from Croatia have reported retinal changes among 45% patients in their study of 40 patients with PIH. The degree of retinopathy was directly proportional to severity of preeclampsia. They stated that hypertensive retinopathy is a valid and reliable prognostic factor in determining the severity of preeclampsia; examination of fundus is a valuable and necessary diagnostic procedure in pregnant women with preeclampsia.⁹ The present study too, in concordance with the preceding studies showed the occurrence and severity of retinopathy to be positively correlated with severity of PIH.

Reddy et al and Tadin I et al found a statistically significant correlation between proteinuria and severity of retinopathy.^{9,11} The results in this study were in harmony with the aforementioned studies as a statistically significant positive correlation was found between severity of proteinuria and retinopathy ($p=0.004$).

In the study by Tandon and Kishore, blood urea level in mild preeclampsia ranged from 19.5 to 30.0 mg% with an average of 24.6 mg% while in severe preeclampsia group, blood urea ranged from 24.0 to 103.0 mg%. In eclamptic women, values ranged from 30.0 to 57.0 mg% with an average value of 43.4mg%.²⁰ In the present study, the mean value of blood urea in mild and severe preeclampsia was 24.24 mg% and 26.67 mg% respectively while in eclampsia group it was 36.86 mg%. The blood urea values were found to bear a statistically significant positive correlation with severity of PIH ($p=0.017$).

In the study by Tandon and Kishore, serum uric acid level in mild preeclampsia ranged from 4.6 to 6.4 mg% with an average of 5.2 mg% whereas in severe preeclampsia group, value of serum uric acid ranged from 4.2 to 8.0 mg% with a mean value of 5.63 mg%. In eclamptic women, values ranged from 6.2 to 11.2 mg% with an average value of 7.2 mg%.²⁰ In the present study as well, the mean values of serum uric acid in mild preeclampsia, severe preeclampsia and eclampsia groups were 4.18 mg% and 4.42 mg% and 5.97 mg% respectively and these serum uric acid values were found to be positively correlated with severity of PIH ($p=0.002$; hence a statistically significant correlation).

CONCLUSION

Fundoscopy is simple, non-invasive, safe and reliable procedure, which can be done in OPD or at bedside, any number of times. It should be done routinely in all patients of pregnancy induced hypertension to interpret the vascular changes in PIH.

In this study, majority of patients showed grade I hypertensive retinopathy (53%) followed by normal fundus (29%). Retinal detachment complicating PIH was seen in two patients. Arteriolar narrowing was the most common fundal abnormality found in patients. This study also shows that with increasing severity of PIH, there are greater chances of development of more severe grade of retinopathy and there are greater chances of occurrence of retinopathy in primigravidae. Retinopathy is more likely to occur in patients having both systolic and diastolic hypertension followed by those having pure systolic hypertension. Chances are least in those with pure diastolic hypertension. Mean Systolic BP and Diastolic BP values in patients with retinopathy are significantly higher than those in patients without retinopathy. Risk of retinopathy is directly proportional to the severity of proteinuria. There is no correlation of retinopathy with maternal age and gestational age. Mean blood urea and mean serum uric acid values increase significantly as the severity of PIH increases.

This study shows that even with increasing health awareness and improving standard of treatment, rare ocular complications of PIH like retinal detachment do occur along with less severe changes of retinal vasculature. Lack of awareness among patients regarding significance of ante-natal hospital visits might be a contributory factor.

REFERENCES

1. Schultz KL, Birnbaum AD, Goldstein DA. Ocular diseases in pregnancy. *Curr Opin Ophthalmol* 2005 Oct;16(5):308-14.

2. Chap 18. Hypertensive disorders of pregnancy. In: Mudaliar & Menon, editor. *Clinical Obstetrics*. 9 th ed. Chennai: Orient Longmann; 1999. p.133.

3. Jaffe G, Schatz H. Ocular manifestation of preeclampsia. *Am J Ophthalmol* 1987 Mar; 103(3):309-15.

4. Capoor S, Goble RR, Wheatley T, Casswell AG. White-centered retinal hemorrhages as an early sign of preeclampsia. *Am J Ophthalmol* 1995 Jun;119(6):804-6.

5. Karki P, Malla KP, Das H, Uprety DK. Association between pregnancy induced hypertensive fundus changes and fetal outcome. *Nepal J Ophthalmol*. 2010;2(1):26-30.

6. Barbazetto IA, Pizzarello LD. Ocular changes during pregnancy. *Compr Ophthalmol Update* 2007 May;8(3):155-67.

7. Chap 12. Retinal vascular disease. In: Kanski JJ, editor. *Clinical ophthalmology*. 4th ed. Butterworth-Heinemann; 1999. p. 495-7.

8. Rogers AH. Vascular disorders hypertensive retinopathy. In: Yanoff M, Duker JS, editor. *Ophthalmology*. 2nd ed. Mosby publications; 2004. p. 852.

9. Tadin I, Bojic L, Mimica M, Karelovic D, Dogas Z. Hypertensive retinopathy and preeclampsia. *Coll Antropol* 2001;25:77-81.

10. Sunness JS. The pregnant woman's eye. *Surv Ophthalmol* 1988 Feb;32(4):219-38.

11. Reddy SC, Naliah S, Rani S. Fundus Changes in Pregnancy Induced Hypertension. *Int J Ophthalmol*; 2012;5(6):694-7.

12. Dieckmann WJ: *The Toxemias of Pregnancy*, 2nd ed. St. Louis, CV Mosby, 1952

13. Beck RW, Gamel JW, Willcourt RJ, Berman G. Acute ischemic optic neuropathy in severe preeclampsia. *Am J Ophthalmol* 1980;90:342-6.

14. Hallum AV. Eye changes in hypertensive toxemia of pregnancy: a study of 300 cases. *JAMA* 1936;106(9):1649-51.

15. Prado RS, Figueiredo EL, Magalhaes TV. Retinal detachment in preeclampsia. *Arq Bras Cardiol* 2002;72(2):185-6.

16. Bharathi NR, raju NS, Prasad PK, Raju RN, Premalatha, Mayee K et al. Fundus changes in pregnancy induced hypertension: A clinical study. *J Med Dent Sci* 2015;4(9):1552-62.

17. Reddy SC. Ocular fundus changes in toxemia of pregnancy. *The Antiseptic*. 1989;86(7):367-372.

18. Sheth BP, Mieler WF. Ocular complications of pregnancy. *Curr Opin Ophthalmol* 2001 Dec;12(6):455-63.

19. Wagener HP. Arterioles of the retina in toxemia of pregnancy. *JAMA* 1933;101(8):1380-4.

20. Kishore N, Tandon S. Significance of biochemical and ophthalmoscopic changes in toxemia of pregnancy. *J Obstet Gynec India* 1965 Dec;15 (6): 551-59.

Source of Support: Nil.

Conflict of Interest: None Declared.

Copyright: © the author(s) and publisher. IJMRP is an official publication of Ibn Sina Academy of Medieval Medicine & Sciences, registered in 2001 under Indian Trusts Act, 1882.

This is an open access article distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite this article as: Pathak Neha, Singh Jaishree, Meena Ashok K, Gupta Tarun, Jain Mukul. One Year Cross-sectional Study of Fundal Changes in Patients with Pregnancy - Induced Hypertension. *Int J Med Res Prof*. 2017; 3(2):68-73. DOI:10.21276/ijmrp.2017.3.2.013