e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(4); 822-825

Original Research Article

A Cross-Sectional Study to Evaluate Retinal Changes in Patients with Hypertension Using Fundus Examination

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Received: 01-01-2026 / Revised: 15-02-2026 / Accepted: 21-03-2026

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Conflict of interest: Nil

Abstract

Background: Hypertension is a major public health problem associated with significant systemic and ocular complications. The retina provides a unique opportunity to directly visualize vascular changes, and Hypertensive Retinopathy serves as an important indicator of target organ damage.

Aim: To evaluate retinal changes in patients with hypertension using fundus examination and to assess their association with clinical parameters.

Materials and Methods: This cross-sectional observational study was conducted on 120 hypertensive patients attending the ophthalmology outpatient department of a tertiary care hospital. Patients aged ≥18 years were included after obtaining informed consent. Detailed demographic and clinical data, including duration and control of hypertension, were recorded. All patients underwent comprehensive ophthalmic evaluation, including fundus examination. Retinal changes were graded using the Keith–Wagener–Barker classification. Statistical analysis was performed using appropriate tests, with $p < 0.05$ considered significant.

Results: Hypertensive retinopathy was observed in 60% of patients. Grade 1 retinopathy was the most common finding (25%), followed by Grade 2 (20.8%), while severe grades were less frequent. A significant association was found between the presence of retinopathy and duration of hypertension as well as blood pressure control status ($p < 0.05$). Patients with longer disease duration and uncontrolled hypertension showed a higher prevalence of retinal changes.

Conclusion: Hypertensive retinopathy is common among hypertensive patients and correlates significantly with disease duration and control. Fundus examination is a valuable, non-invasive tool for early detection and risk assessment, emphasizing the need for regular ophthalmic screening in hypertensive individuals.

Keywords: Hypertension, Hypertensive Retinopathy, Fundus Examination, Retinal Changes, Blood Pressure, Ocular Manifestations.

DOI: 10.25258/ijcpr.18.4.131

Introduction

Hypertension is one of the most common chronic non-communicable diseases worldwide and a leading cause of morbidity and mortality. It significantly contributes to cardiovascular diseases, stroke, and renal failure. According to the World Health Organization, approximately 1.28 billion adults aged 30–79 years globally are affected by hypertension, with a large proportion residing in low- and middle-income countries [1].

In addition to systemic complications, hypertension has important ocular manifestations, primarily affecting the retinal microvasculature. The retina is unique in that it allows direct, non-invasive visualization of blood vessels, making it an important site for detecting early vascular damage. Persistent elevation of blood pressure leads to a spectrum of retinal vascular changes collectively known as Hypertensive Retinopathy. These changes include generalized and focal arteriolar narrowing, arteriovenous (AV) nicking, retinal hemorrhages, hard exudates, and in severe cases, optic disc edema [2].

Hypertensive retinopathy is not merely an ocular condition but reflects systemic vascular damage.

Several studies have demonstrated a strong association between retinal vascular changes and increased risk of stroke, coronary artery disease, and other target organ damage [3]. The severity of retinal changes has been shown to correlate with both the duration and level of blood pressure elevation, making it a useful clinical indicator of disease progression [4].

Fundus examination is a simple, non-invasive, and cost-effective method for detecting these retinal changes. It can be performed using direct ophthalmoscopy or fundus photography. The severity of hypertensive retinopathy is commonly graded using standardized classification systems such as the Keith–Wagener–Barker classification, which categorizes retinal findings into four grades based on their severity [5].

Despite the availability of effective treatment, hypertension often remains undiagnosed or poorly controlled, particularly in developing countries like India. Lack of awareness, irregular treatment, and poor compliance contribute to the progression of disease and its complications. Early detection of retinal changes through routine ophthalmic examination can help identify patients at higher risk and improve management strategies.

Therefore, the present study is undertaken to evaluate retinal changes in patients with hypertension using fundus examination and to correlate these findings with clinical parameters. This study aims to contribute to a better understanding of hypertensive ocular manifestations and emphasize the importance of regular eye evaluation in hypertensive patients.

Aim & Objectives

The aim of the present study is to evaluate retinal changes in patients with Hypertension using fundus examination.

Objectives

1. To determine the prevalence of Hypertensive Retinopathy.
2. To assess the severity of retinal changes.
3. To correlate retinal findings with blood pressure levels and duration of hypertension.
4. To evaluate the association of demographic factors and treatment status with retinal changes.

Materials & Methods

This cross-sectional observational study was conducted in the Department of Ophthalmology at a tertiary care hospital over a period of 6 months. The study included patients diagnosed with Hypertension who attended the outpatient department during the study period.

A total of 100–150 patients aged 18 years and above were enrolled after obtaining informed written consent. Patients with coexisting ocular conditions such as Diabetic Retinopathy, history of ocular trauma or surgery, significant media opacity, and other systemic conditions affecting the retina were excluded from the study.

Detailed demographic and clinical data, including age, gender, duration of hypertension, treatment history, and blood pressure levels, were recorded. Blood pressure was measured using a standard sphygmomanometer under resting conditions.

All patients underwent a comprehensive ophthalmic examination, including visual acuity assessment, slit-lamp biomicroscopy, and fundus examination. Fundus evaluation was performed using direct ophthalmoscopy, and findings were documented. Where available, fundus photography was used for confirmation and record keeping.

Retinal changes were graded according to the Keith–Wagener–Barker classification system. Patients were further categorized based on blood pressure levels, duration of hypertension, and treatment status (controlled vs uncontrolled).

The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as percentages. The association between variables was analyzed using the Chi-square test, and a p-value of <0.05 was considered statistically significant.

The study was conducted after obtaining approval from the Institutional Ethics Committee, and all procedures adhered to ethical standards for human research.

Inclusion criteria:

- Patients aged ≥18 years diagnosed with Hypertension.
- Both newly diagnosed and known cases of hypertension.
- Patients with documented blood pressure records.
- Patients receiving or not receiving antihypertensive treatment.
- Patients willing to participate and provide informed written consent.

Results

A total of 120 patients with hypertension were included in the study. The demographic and clinical characteristics along with retinal findings are presented below.

Table 1: Baseline Characteristics of Study Population

Variable	Category	Number (n=120)	Percentage (%)
Age Group (years)	18–40	20	16.7%
	41–60	55	45.8%
	>60	45	37.5%
Gender	Male	70	58.3%
	Female	50	41.7%

The study included a total of 120 patients diagnosed with Hypertension. The majority of participants were in the 41–60 years age group (45.8%), followed by those aged above 60 years (37.5%). Patients in the 18–40 years category constituted 16.7% of the study population. With respect to gender distribution, males accounted for 58.3% of the participants, while females constituted 41.7%, indicating a male predominance in the study group.

Table 2: Prevalence and Severity of Hypertensive Retinopathy

Parameter	Number	Percentage (%)
Retinopathy Present	72	60%
Retinopathy Absent	48	40%
Grade 1	30	25%
Grade 2	25	20.8%
Grade 3	12	10%
Grade 4	5	4.2%

The prevalence of Hypertensive Retinopathy in the study population was found to be 60%. Among those affected, Grade 1 retinopathy was the most common (25%), followed by Grade 2 (20.8%). More severe forms, including Grade 3 (10%) and Grade 4 (4.2%), were less frequently observed. These findings suggest that early retinal changes are more common, while advanced stages of retinopathy are comparatively less prevalent in the studied population.

Table 3: Association of Clinical Factors with Retinopathy

Variable	Category	Retinopathy Present	Retinopathy Absent	p-value
Duration	<5 years	20	30	<0.05
	5–10 years	28	10	
	>10 years	24	8	
BP Status	Controlled	20	30	<0.05
	Uncontrolled	52	18	

A significant association was observed between the duration of hypertension and the presence of retinopathy ($p < 0.05$). Patients with a longer duration of hypertension (>10 years) showed a higher prevalence of retinal changes compared to those with shorter disease duration.

Similarly, blood pressure control status demonstrated a statistically significant relationship with retinopathy ($p < 0.05$). A greater proportion of patients with uncontrolled hypertension exhibited retinal changes compared to those with controlled blood pressure.

These findings indicate that both prolonged duration and poor control of hypertension are important risk factors for the development of hypertensive retinal changes.

Discussion

The present study was conducted to evaluate retinal changes in patients with Hypertension using fundus examination. The findings demonstrated that hypertensive retinopathy was present in 60% of patients, indicating a high burden of ocular involvement among hypertensive individuals. In the present study, the majority of patients belonged to the 41–60 years age group, with a male predominance. Similar demographic patterns have been reported in previous studies, suggesting that middle-aged individuals are more frequently affected by hypertension and its complications.

The prevalence of Hypertensive Retinopathy in this study (60%) is comparable to findings reported by Wong TY et al., who highlighted that retinal microvascular changes are common among hypertensive patients and may serve as markers of systemic vascular damage [6]. Their study emphasized that even mild retinal changes are clinically significant and associated with increased cardiovascular risk.

In the present study, Grade 1 hypertensive retinopathy was the most common finding, followed by Grade 2, while severe grades (Grade 3

and 4) were less frequent. This pattern is consistent with observations from Kanski's Clinical Ophthalmology, which states that early retinal changes such as arteriolar narrowing and arteriovenous nicking are more commonly encountered in clinical practice, whereas advanced changes are relatively rare and usually associated with severe or malignant hypertension [7]. A statistically significant association was observed between the duration of hypertension and the presence of retinopathy ($p < 0.05$). Patients with a longer duration of disease (>10 years) showed a higher prevalence of retinal changes. This finding is in agreement with the classical observations by Keith NM et al., who reported that prolonged exposure to elevated blood pressure leads to progressive vascular damage and worsening grades of retinopathy [8]. Furthermore, the present study demonstrated a significant relationship between blood pressure control and retinal changes. Patients with uncontrolled hypertension had a markedly higher prevalence of retinopathy compared to those with controlled blood pressure. This finding is supported by studies cited in Parsons' Diseases of the Eye, which emphasize that effective blood pressure control can reduce the risk and progression of hypertensive retinopathy [9]. The results of the present study reinforce the concept that hypertensive retinopathy is not merely an ocular condition but a reflection of systemic vascular damage. Retinal microvascular abnormalities have been shown to correlate with an increased risk of stroke, coronary artery disease, and other end-organ complications, highlighting the importance of early detection and management. However, the present study has certain limitations. Being a hospital-based cross-sectional study, the findings may not be generalizable to the entire population. Additionally, causal relationships cannot be established due to the study design. Despite these limitations, the study provides valuable insights into the ocular manifestations of hypertension in the studied population.

Conclusion

The present study demonstrates that Hypertensive Retinopathy is highly prevalent among patients with Hypertension and is significantly associated with the duration and control of the disease. Early retinal changes were more common, highlighting the importance of timely detection.

Fundus examination serves as a simple, effective, and non-invasive tool for identifying vascular damage and assessing disease severity. Regular ophthalmic screening, along with adequate blood pressure control, can help prevent progression and reduce the risk of vision-threatening and systemic complications.

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