



## Original Research Article

## To evaluate ocular manifestations in primary hypertension

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## ABSTRACT

**Purpose:** To evaluate ocular manifestations in primary severe hypertension.**Material and Methods:** A retrospective chart review of 100 eyes of 50 patients in age group 45-60 years diagnosed with primary severe hypertension (systolic blood pressure [SBP]  $\geq$  180 mm Hg and diastolic blood pressure [DBP]  $\geq$  110 mm of Hg) in a tertiary hospital in 6 months from December 2018 to May 2019. Vision with evaluated with Snellen's chart, fundus was examined with IDO, DO, +90D, +20 D lens and OCT was done.**Results:** Mean age were found to be 51 years  $\pm$ 9.8 under treatment for essential hypertension. Fundus findings included Arteriolar Narrowing (both Focal and Generalized arteriolar Narrowing), Hard Exudates, Cotton Wool Patches, Flame Shaped Haemorrhages, Optic disc edema, Disc haemorrhages. OCT findings included Macular Oedema, Irregular reflection, Sub Retinal Fluid, Inner Retinal Fluid, Hyper Reflective Dots.**Conclusion:** This study can be used as an early diagnostic tool in hypertension. Severe hypertension may lead to may exudative changes. With Arteriolar Narrowing and Hyperreflective Dots within retina as the most common findings. Awareness should be spread regarding ophthalmological examination among patients so that timely measures can be initiated to stop the progression of disease.© This is an open access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

## 1. Introduction

Hypertension is one the most common adult conditions in the industrialized countries with over 65 million Americans having hypertension.<sup>1,2</sup> Hypertension accounts for the largest proportion of cardiovascular deaths in the United States.<sup>3</sup>

Over all prevalence of hypertension in India is 29.8%. Urban it consists of 33%, rural it consists of 25%.<sup>4</sup> Prevalence of hypertensive retinopathy is 66.3%.<sup>5</sup> Hypertension is due to specific causes in a small fraction of cases, but in the vast majority of individuals ( $\approx$ 90%), its aetiology cannot be determined; therefore, the essential hypertension term is employed.<sup>6,7</sup>

Based on these fundoscopic features, Keith et al. developed a classification system for hypertensive

retinopathy. This classification is widely used in current clinical practice, but Wong and Mitchell most recently proposed a simplified hypertensive retinopathy grading system (Table 1).

This study aims at studying and evaluating the common fundus findings and OCT features of the patients of severe primary essential hypertension.

## 2. Materials and Methods

A retrospective chart review was performed on 100 eyes of 50 patients. All patients had hypertensive retinopathy diagnosed between December 2018, and May 2019, and complained of blurred vision, with or without headaches, within 2 weeks of the initial visit.

All included patients had normal visual acuities in both eyes before the symptom onset. All patients had a systolic BP > 180 mm Hg or a diastolic BP > 110 mm Hg at the

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**Table 1:** Classification Systems for Hypertensive Retinopathy

Classification	Category	Funduscopy Findings
Keith-Wagener-Barker	1	Mild generalized arteriolar narrowing or sclerosis
	2	Definite focal narrowing and arteriovenous crossings; moderate to marked sclerosis of the retinal arterioles
	3	Signs of grade 2 retinopathy plus retinal haemorrhages, exudates, and cotton wool spots
	4	Severe grade 3 retinopathy plus papilledema
Wong and Mitchell	Mild	1 or more of the following signs: generalized arteriolar narrowing, focal arteriolar narrowing, arteriovenous nicking, arteriolar wall opacity
	Moderate	1 or more of the following signs: retinal haemorrhage (blot-, dot-, or flame-shaped), microaneurysm, cotton wool spot, hard exudates
	Malignant	Moderate retinopathy plus optic disc swelling

initial visit, at which SD-OCT (Spectralis OCT; Heidelberg Engineering, Inc., Heidelberg, Germany) was performed.

Patients with history of ocular trauma, macular disease, diabetic retinopathy, ocular surgery, or high myopia (>6 diopters [D]) were excluded. The study conduct adhered to the tenets of the Declaration of Helsinki.

### 2.1. Ophthalmic examinations

All patients underwent a complete ophthalmic examination, which included best-corrected visual acuity (BCVA) measurement, slit-lamp biomicroscopy, indirect ophthalmoscopy, fundus photography (VX-10; Kowa Optimed, Tokyo, Japan), and SD-OCT imaging. Fundus photographs were used to determine the commonest fundus findings in the patient. Based on fundoscopic features and the OCT findings list of features were generated and evaluated.

The SD-OCT scans with eye-tracking system were performed at a scan rate of 40,000 A-scans/s over a 4.5–3.6-mm area. The macular thickness protocol acquires a 512×128 scan macular cube, which was used for quantitative evaluation of macular thickness. OCT images were used to evaluate the structural integrity of the retinal layers and any abnormal retinal features.

### 2.2. Data analyses

Data for continuous variables are expressed as mean ± standard deviation, where applicable. Visual acuity measurements were analysed as it is from the snellens chart to keep the results more subtle. Mean arterial pressure (MAP) was calculated from SBP and DBP measurements.

Linear regression analyses were performed to evaluate the association of SBP, DBP, and MAP with CMT, SRF height, and choroidal thickness. Frequency and incidence data were compared using a  $\chi^2$  test or Fisher's exact test.

Grades of hypertensive retinopathy were examined for correlations with baseline BCVA. To identify clinical and OCT features significantly and independently Statistical analyses were performed using SPSS for Windows (Ver. 18.0 Statistical Package for the Social Sciences; SPSS, Inc., Chicago, IL, USA), and P values < 0.05 were considered statistically significant.

### 3. Results

This study included 100 eyes of 50 patients (33 male, 17 female), who were diagnosed with severe hypertension and were examined with SD-OCT on the day of initial BP measurement.

Patient clinical characteristics are summarized in Table 2. Mean patient age was 54 ± 5.5 years (range, 45–60 years).

At baseline, mean systolic and diastolic BP were 214 ± 23; range 180–280 and 119 ± 13; range 94–180 respectively, and average MAP was 154 ± 18; range 130–206 mm Hg.

**Table 2:** Clinical Characteristics

<b>Sex, male: female</b>	33:17 (no. of patients) (66:34)
Age	54 ± 5.5; range, 45–60
Refractive error	-1.4 ± 1.2; range, -5.0 to +1.25
Blood pressure (mm Hg)	
Systolic pressure	214 ± 23; range 180–280
Diastolic pressure	119 ± 13; range 94–180
Mean arterial pressure	154 ± 18; range 130–206

The association between BP level and fundoscopic change severity is demonstrated, with arteriolar narrowing, hard exudates, flame-shaped retinal haemorrhages, cotton wool spots, and disc edema. These abnormalities were typically located around the optic nerve head and the larger arterioles. Hard exudates, cotton wool spots, and flame-shaped retinal haemorrhages were noted on fundus examination in 48(48%), 88(88%), and 47(47%) eyes, respectively (Table 3). Optic disc oedema and haemorrhage were also observed in 44(44%) and 8(8%) eyes, respectively.

Table 4 demonstrate how macular edema, SRF, irregular reflection, retinal nerve fiber layer thickening, and intraretinal hyperreflective dots are represented on OCT. Intraretinal hyperreflective dots correspond to hard exudates in fundus photographs. Irregular reflection and retinal nerve

**Table 3:** Fundusoscopic findings

Fundusoscopic finding	n (%)
Hypertensive retinopathy	100 (100)
Arteriolar narrowing	100 (100)
Hard exudates	48 (48)
Cotton wool patch	88 (88)
Flame-shaped retinal hemorrhages	47 (47)
Optic disc oedema	44 (44)
Disc hemorrhages	8 (8)

fiber layer thickening, SRF, intraretinal fluid, and macular oedema, intraretinal hyperreflective dots were noted in 32(32%), 47(47%), 28(28%), 38(38%), and 58(58%) eyes, respectively. All 21 patients who had SRF had sub foveal SRF. Hyperreflective dots within the retina were most often found in the outer nuclear layer, but their location ranged from the subretinal space to the ganglion cell layer. Intraretinal fluid was most often found in the outer nuclear layer.

**Table 4:** Optical coherence tomography findings

OCT finding	n (%)
Macular oedema	38(38)
Irregular reflective region	32(32)
Subretinal fluid	47(47)
Inner retinal fluid	28(28)
Hyperreflective dots within retina	58(58)

#### 4. Discussion

This study investigated morphologic changes of the retina in patients with severe hypertension. These changes were correlated with several BP parameters. These retinal changes occurring during severely elevated BP can be resolved within a short period of time after BP control, but will lead to visual loss because of incomplete photoreceptor recovery and the nerve fiber layer defects. Retinal changes observed in patients with severe (malignant) hypertension included intraretinal transudate, multiple cotton wool spots, and retinal haemorrhages. Additionally, OCT revealed intraretinal fluid and SRF in majority of patients with severe hypertension. Intraretinal transudate results from breakdown of the retinal arteriole blood–retinal barrier caused by highly elevated BP. The peripapillary and periarteriolar appearance of retinal changes is a characteristic feature of hypertensive retinopathy and is helpful in distinguishing it from other conditions causing retinal haemorrhage, edema, and exudates.

Cotton wool spots were very common in our patients with severe hypertension. In SD-OCT, irregular reflection and swelling of the retinal nerve fiber layer were identified as a result from ischemic damage to the nerve fiber layer corresponding to the cotton wool spot. Irregular reflections in OCT images is due to flame-shaped retinal hemorrhages

present in the nerve fiber layer. Cotton wool spots, are significant because they represent permanent nerve fiber layer defects and gets resolved mostly in one month of treatment.

Population-based data have shown a significant association between some hypertensive retinopathy grades (i.e., moderate or malignant) and risk of stroke, coronary artery disease, and death.<sup>8,9</sup>

Our study had few limitations, the retrospective design results in intrinsic drawbacks, namely, selection bias.

#### 5. Conclusion

We have concluded that there is a very strong association between retinal vasculature changes and the hypertensive status of the patients. Our study shows 100% of the patient has Arteriolar Narrowing which is supported by Tien Yin Wong et al study which has shown 70-80% of the hypertensive are more likely to develop AV nicking.<sup>10</sup>

Similarly presence of cotton wool patches was found to be 88 % which corresponds to the Tien Yin Wong et al study which shows strong association between cardiovascular risk and hypertension.<sup>10</sup> IRHRD is seen in 58% of the subjects in our study which co relates with the study of Seong Joon Ahn et al which shows 61.9% of patients has IRHRD.<sup>11</sup>

IRR and SRF is seen in 28% and 47% of the patients respectively where as Seong Joon Ahn et al found it to be 33.3% and 50% respectively.<sup>11</sup> This Study can be used as an early diagnostic tool in essential hypertension as the ocular manifestation can be easily and conveniently be observed and can play a major role in preventing visual loss and also the target organ damage.

#### 6. Conflict of Interest

The authors declare no potential conflicts of interest.

#### 7. Source of Funding

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