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Original Research Article

Pattern of Ocular Manifestations in Patients with Systemic Hypertension: A Cross-Sectional Study

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Abstract

Background: Microvascular changes in the retina, choroid, and optic nerve head are caused by systemic hypertension. Ocular signs can be present but not cause any symptoms, and can be a visible sign of systemic vascular injury.

Methods: This was a cross sectional study of 250 adults with a diagnosis of systemic hypertension seen in a tertiary care outpatient department. Demographic data, hypertension duration, blood pressure control, treatment status, and systemic comorbidities were recorded. All participants had visual acuity testing, slit-lamp examination, intraocular pressure measurement, and dilated fundus examination. The modified Keith-Wagener-Barker criteria were used to grade hypertensive retinopathy.

Results: The mean age was 54.6 +/- 10.8 years and mean duration of hypertension was 7.1 +/- 5.4 years. Ocular manifestations were found in 146 patients (58.4%). The most frequent abnormalities were hypertensive retinopathy (52.8%), narrowing of the retinal arterioles (44.0%), arteriovenous nicking (31.6%), retinal haemorrhages (12.8%), cotton wool spots (8.4%) and optic disc oedema (1.6%). Patients with a duration of hypertension >10 years had a significantly higher prevalence of retinopathy (76.3%) than patients with a duration of hypertension of <=5 years (37.6%; p<0.001). Poor blood pressure control (OR=3.48, 95% CI: 1.92-6.31; p<0.001) was strongly associated with grade II or higher retinopathy.

Conclusion: Ocular findings are frequently seen in patients with hypertension and are related to the duration and control of hypertension. Routine examination of the fundus may be useful for systemic risk assessment in hypertension.

Keywords: Systemic Hypertension, Hypertensive Retinopathy, Fundus Examination, Target Organ Damage, Cross-Sectional Study.

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Introduction

Systemic hypertension is a primary non-communicable disease and a primary cause of cardiovascular, cerebrovascular, renal and ocular morbidity. The retina is a unique microvascular system that can be directly observed and thus provides a window into the health of the microvascular system in the body. Ocular target-organ involvement from chronic or high blood pressure includes hypertensive retinopathy, choroidopathy and optic neuropathy [1].

The classical hypertensive retinal changes are generalized and focal arteriolar narrowing, arteriovenous crossing changes, copper or silver wiring, flame-shaped hemorrhages, hard exudates, cotton wool spots, macular edema and optic disc edema in malignant hypertension. These signs are indicative of vasoconstriction, arteriolosclerosis, endothelial disruption and breakdown of the inner blood-retinal barrier. Older classifications like Keith-Wagener-Barker still have a clinical familiarity, and newer classifications correlate retinal signs with systemic vascular risk [2].

Population-based and clinical studies have shown that signs of hypertensive retinopathy are independent of conventional risk factors for stroke, coronary heart disease, heart failure, chronic kidney disease and mortality. Even though mild microvascular abnormalities of the retina may not

be considered a significant finding, they should not be ignored, as they may have prognostic significance, said Wong and Mitchell [3]. Ocular symptoms are usually absent, especially in early grades, in many patients. This is a missed opportunity for risk stratification as patients may not seek ophthalmic evaluation until they develop vision-threatening complications. On the other hand, during routine care, fundus examination can detect uncontrolled hypertension, longstanding disease or possible malignant hypertension that may need urgent systemic evaluation.

Despite the advances in antihypertensive therapy and imaging technology, the importance of hypertensive retinopathy has been emphasized in recent reviews. In addition to these, direct ophthalmoscopy and slit-lamp biomicroscopy are still widely used, low-cost tools in clinical settings, and have improved detection with the use of optical coherence tomography, fundus photography and automated retinal vascular analysis [4].

The aim of the present cross-sectional study was to assess the pattern of ocular manifestations in systemic hypertension patients and to determine the relationship between these manifestations and duration of hypertension, blood pressure control and systemic comorbidities. The goal was to produce clinically relevant data to support the integration of ophthalmic and medical care for hypertensive adults.

Materials and Methods

This was a cross sectional study of one year duration in the ophthalmology and medicine OPD of a tertiary care teaching hospital. A total of 250 patients with previously diagnosed systemic hypertension were enrolled by consecutive sampling after obtaining informed consent.

Adults of 30 years old or older who had a documented history of hypertension or were receiving treatment for hypertension were included. To minimize confounding, patients with diabetes mellitus with diabetic retinopathy, retinal vascular occlusion (not related to hypertension), high myopia, media opacity that prevented fundus examination, previous retinal laser therapy, and intraocular surgery within the last six months were excluded.

Demographic data, duration of hypertension, medication adherence, smoking history, body mass index and comorbidities were documented. Five minutes of rest were allowed before taking blood pressure with a calibrated sphygmomanometer. Poor control was considered when the patient had a systolic blood pressure (SBP) >=140 mmHg and/or a diastolic blood pressure (DBP) >=90 mmHg at the study visit or had documented uncontrolled blood pressure during follow-up.

Ophthalmic examination consisted of Snellen visual acuity, anterior segment examination, intraocular pressure measurement and dilated fundus examination with slit-lamp biomicroscopy using a 90D lens. Retinal findings were systematically documented. The severity of hypertensive retinopathy was assessed by modified Keith-Wagener-Barker classification, and the presence of macular and optic nerve changes were recorded independently.

The data were analysed with SPSS version 26. The quantitative variables were presented as mean ± SD and the categorical variables were presented as numbers and percentages. Associations between retinopathy and categorical predictors were evaluated using chi-square test. Independent t-test is used to compare means between groups. Logistic regression was used to determine the factors associated with grade II or higher retinopathy. A p-value <0.05 was deemed as statistically significant.

Results

The study dataset was checked for completeness before analysis. All enrolled participants had complete clinical records and laboratory or imaging values required for the primary outcomes. Descriptive and inferential results are presented in the following tables.

Table 1: Baseline clinical profile of hypertensive patients (n=250).

Variable	Category/Measure	Value
Age	Mean +/- SD	54.6 +/- 10.8 years
Sex	Male	132 (52.8%)
Sex	Female	118 (47.2%)
Hypertension duration	Mean +/- SD	7.1 +/- 5.4 years
Duration category	<=5 years	109 (43.6%)
Duration category	6-10 years	65 (26.0%)
Duration category	>10 years	76 (30.4%)
Blood pressure control	Controlled	104 (41.6%)
Blood pressure control	Poorly controlled	146 (58.4%)

Table 1 shows that the study sample included middle-aged and elderly hypertensive adults, with more than half demonstrating poor blood pressure control at assessment.

Table 2: Pattern of ocular manifestations in systemic hypertension.

Ocular finding	Number	Percentage
Any ocular manifestation	146	58.4%
Hypertensive retinopathy	132	52.8%
Generalized arteriolar narrowing	110	44.0%
Arteriovenous nicking	79	31.6%
Focal arteriolar narrowing	64	25.6%
Retinal hemorrhages	32	12.8%
Hard exudates	27	10.8%
Cotton wool spots	21	8.4%
Optic disc edema	4	1.6%

Table 2 demonstrates that hypertensive retinopathy was the dominant ocular manifestation. Most cases were non-proliferative retinal vascular changes, while disc edema was uncommon and restricted to severely uncontrolled blood pressure.

Table 3: Association of hypertensive retinopathy with duration and BP control.

Variable	No/Grade I retinopathy	Grade II or higher	p-value
Duration <=5 years	68 (62.4%)	41 (37.6%)	<0.001
Duration 6-10 years	32 (49.2%)	33 (50.8%)	
Duration >10 years	18 (23.7%)	58 (76.3%)	
Controlled BP	68 (65.4%)	36 (34.6%)	<0.001
Poorly controlled BP	50 (34.2%)	96 (65.8%)	

As shown in Table 3, increasing duration of hypertension and poor current blood pressure control were significantly associated with more advanced retinopathy.

Multivariable logistic regression showed that hypertension duration >10 years (adjusted OR=2.91, 95% CI: 1.55-5.47; p=0.001), poor BP control (adjusted OR=3.48, 95% CI: 1.92-6.31; p<0.001), and smoking (adjusted OR=1.84, 95% CI: 1.01-3.36; p=0.046) independently predicted grade II or higher retinopathy. Age and sex were not independently significant after adjustment. Visual acuity was preserved in most participants, indicating that many ocular changes were detectable before major subjective visual impairment.

Discussion

In this study, almost 60% of patients with systemic hypertension had eye changes, and the most common eye change was hypertensive retinopathy. Arteriolar narrowing and arteriovenous nicking were more common than were cotton wool spots, disc edema, exudates, and hemorrhages. These results are consistent with the known sequence of events in more severe disease, which is vasoconstrictive and sclerotic changes followed by exudative changes [1,2].

The high prevalence of advanced retinopathy in association with poor BP control further emphasizes the role of the eye as a target organ in hypertension. Fundus abnormalities are not only local but are also systemic microvascular injuries. Wong and Mitchell referred to hypertensive retinopathy as a marker of cardiovascular risk, and later studies have confirmed the association of retinal features with stroke and heart disease [3,5].

Another important determinant was the duration of hypertension. The prevalence of grade II or higher changes was significantly higher in patients with disease duration > 10 years. This is probably due to the progressive thickening of the arteriolar walls, endothelial dysfunction and chronic exposure to pulsatile pressure. However, length of time is not enough as recently diagnosed patients with severe uncontrolled hypertension can also have significant retinal changes.

The low prevalence of optic disc edema is not surprising as this is an outpatient sample and malignant hypertension is less common and more likely to require emergency care. However, the recognition of even a few of these cases is of clinical significance as it can be a sign of acute target-organ damage in a hypertensive patient and require immediate systemic therapy.

Ophthalmic examination is useful in the multidisciplinary care. Physicians follow many patients with hypertension, but do not routinely perform fundus exams unless they have visual symptoms. This study demonstrates that a large percentage of them have retinal changes even though they have normal vision. Ocular screening may enhance awareness, adherence and escalation of treatment if necessary, on a periodic basis.

The advantages of this study are that it had a well-defined cohort of patients with hypertension, a standardized ophthalmic examination, a

standardized grading of retinopathy, and analysis of blood pressure control and duration of disease. Exclusion of DR resulted in less overlap between the microvascular changes associated with HTN and DR, but there was still some residual confounding due to age and vascular comorbidities. [8,9] The limitations are cross-sectional design, single visit blood pressure classification and lack of masked grading using fundus photography. The study does not allow the researchers to conclude if retinal signs get better over time if blood pressure is better. Future studies with retinal imaging, ambulatory blood pressure monitoring, renal markers and cardiovascular outcomes would yield more evidence for the prognostic value.

A significant finding was that a large proportion of the participants with retinal vascular changes did not complain of an eye problem. This highlights the importance of not relying solely on symptoms for referral of hypertensive eye disease. The retinal examination may also be a counselling tool: demonstrating or explaining the changes in the fundus may help the patient to better understand hypertension as a systemic condition, not just one that is measured at clinic visits. [10]

This correlation between retinal findings and systemic risk should be a call to action for ophthalmologists, physicians and primary care providers to work together. If grade II or higher retinopathy is seen, review of antihypertensive adherence, renal function, lipid status, diabetes screening and cardiovascular risk profile should be considered. However, if patients have poorly controlled hypertension, they should be referred for fundus evaluation even if they have normal visual acuity. [11-15] In resource-poor environments, direct ophthalmoscopy may continue to be the first exam but non-mydriatic fundus photography may enhance documentation and facilitate comparison for follow-up. Retinal photographs also enable screening and interobserver review using teleophthalmology. Hypertensive retinopathy could become more of a quantitative microvascular risk estimation with the increasing availability of artificial intelligence-based retinal vascular analysis.

The public health significance is significant as hypertension is prevalent, asymptomatic and under-treated. The target-organ involvement can be detected at an early stage by a simple fundus examination, before systemic intervention may cause stroke, renal decline and cardiac complications.

The current results thus justify the inclusion of eye examination in the comprehensive hypertension clinics. One other consideration is that retinal vascular changes can be related to both current blood pressure and vascular damage. The blood pressure may be normal on the day of examination but the arteriolar narrowing or arteriovenous nicking may be present due to years of previous exposure. Thus, the lack of acute elevation should not preclude the possibility of significant hypertensive ocular damage and when possible, longitudinal blood pressure records should be reviewed. [16] The severity of the hypertensive retinopathy should also be conveyed in a manner that can be acted upon by the physicians. The report of "hypertensive changes" is less helpful than one that includes the grade, presence or absence of hemorrhages, exudates, cotton wool spots, macular edema, or disc edema. Structured reporting can enhance the urgency of referrals and systemic treatment decisions.

Retinal signs are useful but should not be used in lieu of systemic evaluation. Target-organ assessment continues to be important and includes kidney function, urine albumin, electrocardiographic or echocardiographic evaluation, lipid profile, and diabetes screening. The eye provides visible microvascular evidence and can enhance the diagnostic confidence if the systemic risk is underestimated. Patient education is also at the core. A large number of patients stop taking antihypertensive medications when they don't have any symptoms. Educating patients about the possibility of damage to the retinal vessels before vision loss may increase compliance. The ophthalmology visit can then serve as a reminder to the public to maintain lifelong blood pressure control and regular blood pressure monitoring. Macular involvement and disc edema were rare but significant in this study. The visual symptoms may be disproportionate in macular edema and raised ICP or malignant hypertension may be part of the differential diagnosis in disc edema. Such findings should be emphasized and should be evaluated systemically as soon as possible, not as a routine outpatient follow-up.

In the sample analysed, there was no diabetic retinopathy, which reinforced the findings of the study to be attributed to hypertension, but in real life, patients often suffer from both diabetes and hypertension.

Retinal signs are more likely to be present in combined disease and systemic risk is even higher. Therefore, all vascular features and any pertinent systemic history should be documented in the eye rather than trying to assign a single cause.

In conclusion, the results support a pragmatic approach to fundus examination that is done at diagnosis, repeated when BP control is inadequate, and emphasized in patients with long disease duration or other vascular risk factors. This is a viable, low cost, clinically informative method in both tertiary and secondary care.

Conclusion

Patients with systemic hypertension often have eye signs and disease duration and poor blood pressure control are strongly correlated with eye signs. Retinopathy, especially grade II or more, may be a readily available indicator of microvascular injury.

The fundus examination should be part of the routine examination of the hypertensive adult.

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