Original Research Article

A Study on fundus changes in patients with essential hypertension and malignant hypertension

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Abstract

Ocular changes in malignant hypertension can be striking, with optic neuropathy, choroidopathy, and retinopathy. Changes from essential hypertension are subtler, affecting primarily the retinal vasculature. Because hypertension is so prevalent in industrialized countries, hypertensive retinopathy is a common condition encountered by all ophthalmologists and health-care professionals. After proper selection of the patients, their informed consent was obtained for the study. A detailed medical history was taken from every patient and evidence of any systemic complications of hypertension was noted. This was followed by detailed medical examination including physical examination. Out of 148 patients with retinopathy66 (22%)patients had Grade I, 73(24.4%) had Grade II,4(1.33%) had Grade III, 1(0.33%) had Grade IV, 1(0.33%) had ITBRVO,2(0.7%) had HRVO and 1(0.3%) had STBRVO. In our study at follow-up after 3 months ,we observed that there was no significant change in BCVA and Grade of retinopathy

Keywords: Fundus changes, Essential hypertension, Malignant hypertension.

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INTRODUCTION

Systemic hypertension is defined by the American Seventh Joint National Commission Report, USA (JNCV7) as a state of persistent elevated blood pressure above 140/90 mm of Hg based on an average of two or more seated blood pressure readings taken on two or more visits. Hypertension affects approximately 1 billion people worldwide .[1]

Hypertensive retinopathy represents the ophthalmic findings of end-organ damage secondary to systemic arterial hypertension. Although its name implies only retinal involvement, changes in both the choroid and the optic nerve are observed, depending on the chronicity and severity of the disease.[2] The overall rates of hypertensive retinopathy in the non diabetic population ranges from 0.8% to 7.8%.[3] The study of populations is difficult and highly variable because of different evaluation methods , grading classification of retinopathy, selection bias groups, and the association of other systemic diseases.

Ocular changes in malignant hypertension can be striking, with optic neuropathy, choroidopathy, and retinopathy. Changes from essential hypertension are subtler, affecting primarily the retinal vasculature. Because hypertension is so prevalent in industrialized countries, hypertensive retinopathy is a common condition encountered by all ophthalmologists and health-care professionals.[1]

The retina provides an open and accessible window for studying the microcirculation in the human body. Retinal vessels can be easily visualized with non-invasive techniques providing valuable information in patients of hypertension and cardiovascular diseases.[4]

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For many years physicians used to perform traditional fundoscopy, which provides an overview of the retina and vitreous of the eye, by the use of a direct or indirect ophthalmoscope or with a slit lamp.

However, all of the above mentioned methods present several important drawbacks; in particular, they are prone to operator bias, since image recording is not feasible, and do not permit the assessment of more sophisticated measurements of retinal vessels, such as the diameter of the vessels.[5]

In addition, prior medical mydriasis is required, and presence of specially trained examiners is necessary. These important drawbacks have been counterbalanced by the development of advanced fundus cameras (mydriatic or non-mydriatic), allowing thus the accurate, objective, and repeatable representation of retinal blood vessels, and providing further insights in the diagnosis, classification and surveillance of retinopathy signs.[6] Physicians have used hypertensive retinopathy to predict risk of stroke, cardiovascular disease, and even mortality. As a result, the assessment of hypertensive retinopathy signs appears in clinical guidelines for the management of patients with hypertension.[7,8] Thus this study highlights the role of fundus camera in studying retinal changes in hypertension. This deals with the analysis of colour fundus images with its applications in the evaluation of hypertensive retinopathy.

METHODOLOGY

Source of Data

Hypertensive patients of either sex, aged >40years ,who fulfill the inclusion and exclusion criteria attending the outpatient department of Ophthalmology, and those patients referred from other departments.

Sample Size: 300 patients.
Sampling Method: Simple Random Sampling

Inclusion Criteria

1. Essential hypertension – Systolic BP >140 mm of Hg or Diastolic BP > 90 mm of Hg.
2. Malignant hypertension – Systolic BP > 200 mm of Hg or Diastolic BP > 140 mm of Hg.
3. Elevated BP associated with retinal venous obstruction, neovascularisation, arterial emboli.

Exclusion Criteria

1. Diabetic retinopathy.
2. Collagen vascular disease; Hyperviscosity syndrome.
3. Anaemic retinopathy, sickle cell retinopathy, Radiation retinopathy.
4. Toxemia of pregnancy.
5. Ocular ischemic syndrome.

Procedure

After proper selection of the patients, their informed consent was obtained for the study. A detailed medical history was taken from every patient and evidence of any systemic complications of hypertension was noted. This was followed by detailed medical examination including physical examination. Patients who presented with any of the exclusion criterion like diabetes mellitus to avoid overlapping of the pathophysiology of the two systemic diseases on the retina, were excluded from the study. Routine ocular work up was carried out including visual acuity, refraction, IOP measurement and slit lamp examination. Detailed fundus examination was carried out in all patients after full dilatation of the pupil with 1% Tropicamide with 5% Phenylephrine and recorded using OIS eye scan mydriatic fundus camera. All cases were categorized depending upon the presence or absence of hypertensive retinopathy. Cases with hypertensive retinopathy were graded in to 4 classes on the basis of Keith-Wagener-Barker Classification. Patient were subjected to investigations where in appropriate. The patient was advised appropriate management in consultation with concerned departments and followed up for response to treatment for a minimum period of 3 months.

The following investigations and interventions were performed on the patients.

1. BP measurement
2. Visual acuity testing
3. Refraction
4. Slit lamp biomicroscopy
5. Tonometry
6. Fundus examination
7. B-Scan ultrasonography
8. Renal function test
9. Lipid profile
10. Blood sugar measurement

Following additional investigations were done for patients when required

1. Immunological markers
2. Cardiac status assessment (ECG, Echo)
3. Imaging studies (CT, MRI, and Ultrasound)
4. Renal biopsy
5. Urine VMA

RESULTS

Table 1: Sex wise distribution of patients with hypertensive retinopathy

SEX		FUNDUS Positive	Total
FEMALE	Number	75	75
	%	50.3%	50.3%
MALE	Number	73	73
	%	49.7%	49.7%
Total	**Number**	**148**	**148**
	%	**100.0%**	**100.0%**

Out of 300 patients 49.7 %(149) patients were females and 50.3% (151) were males. Among the patients with hypertensive retinopathy 49.7 %(73) were males and 50.3 %(75) were females.

Table 2: Distribution of cases age wise

			Retinopathy		
Age in years			Present	Absent	Total
	40-50	Number	19	55	74
		%	**12.8%**	**36.2%**	**24.7%**
	50-60	Number	45	56	101
		%	**30.5%**	**36.8%**	**33.7%**
	60-70	Number	48	34	82
		%	**32.4%**	**22.4%**	**27.3%**
	70-80	Number	28	6	34
		%	**18.9%**	**3.9%**	**11.3%**
	>80	Number	8	1	9
		%	**5.4%**	**.7%**	**3.0%**
	Total	Number	148	152	300
		%	100%	100%	100%

Majority of the patients ,101(33.7%) were in the age group 50-60 years, followed by 82(27.3%) in 60-70years group, followed by 74(24.7%) in 40-50 years group followed by 34(11.3%) in 70-80 years group and 9(3%) in >80 years group. Among the 101 patients in the age group 50-60, 45 (30.5%) were having hypertensive retinopathy; 48(32.4%) out of 82 patients in the age group 60-70 were affected .8 (5.4%) out of 9 in the age group >80 years had features of retinopathy. Mean age is 56.90±10.394.Standard error of mean is 0.600. From this data the association between age and incidence of hypertensive retinopathy was found to be highly significant. ($p<0.05$)

Table 3: Distribution of visual acuity among the population

BCVA	RE		LE	
6/6	277	**92.34%**	278	**92.6%**
6/9-6/18	21	**7%**	19	**6%**
6/18-6/24	-		5	**1.1%**
6/60	-		1	**0.3%**
5/60	1	**0.33%**	-	-
PL,PR	1	**0.33%**	-	-
Total	300	**100%**	300	**100%**

At the time of examination, majority of the patients, [277(92.34%) in RE and 278(92.6%) in LE] had normal visual acuity. In the RE 21(7%) patients were having BCVA ranging from 6/9-6/18 in RE.1 (0.3%) patient had 5/60 and 1(0.3%) had PL, PR+. In the LE 19 (6%) had BCVA of 6/9-6/18, 5(1.1%) had 6/18-6/24 and 1(0.3%) had 6/60.

Table 4: Distribution of anterior segment findings among patients

Anterior segment Examination	Number	Percent
EARLY LENTICULAR CHANGES	5	**1.7**
NAD	280	**93.3**
PSEUDOPHAKIA	15	**5.0**
Total	**300**	**100.0**

In our study, majority 280 (93.3%) had no abnormalities in the anterior segment. 15(5%) were pseudophakic and 5(1.7%) had early lenticular changes

Table 5: Distribution of fundus findings among 300 hypertensive patients

Fundus Finding	Present	Percentage	Absent	Percentage	P value
Arteriolar narrowing	148	**49.3**	152	**50.7**	0.000(<0.05)
Av nicking	82	**27.3**	218	**72.7**	0.000(<0.05)
Salu's sign	73	**24.3**	227	**75.7**	0.000(<0.05)
Bonnet sign	12	**4**	288	**96**	0.000(<0.05)
Gunn sign	12	**4**	288	**96**	0.000(<0.05)
Haemmorhages	12	**4**	288	**96**	0.000(<0.05)
Cotton wool spots	12	**4**	288	**96**	0.000(<0.05)
Disc oedema	02	**0.7**	298	**99.3**	0.000(<0.05)
Others	04	**1.3**	296	**98.7**	0.000(<0.05)

Out of 300 patients arteriolar narrowing was present in 148(49.3%) patients, AV nicking in 82(27.3%),Salu's sign in 73(24.3%),Bonnet sign in 12(4%),Gunn sign in 12(4%),haemorrhages in 12(4%),Cotton wool spots in 12(4%),disc oedema in 2(0.7%)and other complications in 1.3%

Table 6: Distribution of hypertensive retinopathy and its complications among the patients

GRADES OF RETINOPATHY	Number	Percent
CRAO	1	**0.3%**
GRIHTR	66	**22%**
GRIIHTR	75	**25%**
GRIIIHTR	4	**1.3%**
GRIVHTR	1	**0.3%**
NAD	152	**50.7%**
NAION	1	**0.3%**
Total	**300**	**100%**

Among the 300 patients examined 152 were normal. Out of 148 patients with retinopathy66 (22%)patients had Grade I, 75(25%) had Grade II,4(1.33%) had Grade III, 1(0.33%) had Grade IV and 1(0.33%) had NAION.

Table 7: Distribution of hypertensive retinopathy and its complications among patients

GRADES OF RETINOPATHY	Number	Percent
GRIHTR	66	**22%**
GRIIHTR	73	**24.4%**
GRIIIHTR	4	**1.3%**
GRIVHTR	1	**0.3%**
INFERIOR HRVO	2	**0.7%**
ITBRVO	1	**0.3%**
NAD	152	**50.7%**
STBRVO	1	**0.3%**
Total	**300**	**100%**

Among the 300 patients examined ,152 were normal. Out of 148 patients with retinopathy66 (22%)patients had Grade I, 73(24.4%) had Grade II,4(1.33%) had Grade III, 1(0.33%) had Grade IV, 1(0.33%) had ITBRVO,2(0.7%) had HRVO and 1(0.3%) had STBRVO. In our study at follow-up after 3 months, we observed that there was no significant change in BCVA and Grade of retinopathy.

DISCUSSION

In the present study 300 hypertensive patients of both sexes, >40yrs of age were taken up and subjected for fundus examination with mydriatic fundus camera and were categorized into various grades of hypertensive retinopathy according to Keith Wagener and Barker classification. In this study the prevalence of hypertensive retinopathy among hypertensive people was 49.3%. In Beaver Dam eye study it was 2.8-19.4% in hypertensive population.[6] BMES study showed a prevalence of 6.8-15.4%[7], CHS Study showed prevalence of 9-12.3 %[9] and ARIC study showed a rate of 51.6%. The high prevalence in our study may be accounted as our hospital is a tertiary centre and the only such hospital in the surroundings. Most of our patients were from a rural background and were diagnosed at a later stage and they had very low awareness

about the disease. Moreover in our study we used the mydriatic fundus camera through which we were able to detect even minor alterations in the vascular architecture. In our study the duration of hypertension ranged from<1year to >15 years.50.7% of patients were having a duration less than 5 years. 4.3% of patients had duration of hypertension more than 15 years and retinopathy was a consistent feature among these patients. The association of duration of hypertension and hypertensive retinopathy is well established in our study. Leung H *et al* documented the independent effects of both current and past blood pressure on small vessel caliber in the retina, suggesting that retinal arteriolar narrowing may result from the cumulative effects of long-standing hypertension.[10] In this study, there was almost equal incidence of hypertensive retinopathy among both the sexes. Sharp PS *et al* in his study of Hypertensive Retinopathy in Afro- Caribbeans and Europeans showed an increased prevalence in women.[11] The prevalence of retinopathy was higher in males, when adjusted for age, both in the Beaver Dam and in the ARIC study. However, in the Blue Mountains, no difference was found. Through this study, as per table no. 3, we found a statistically significant association between age and hypertensive retinopathy. Data from the Beaver Dam and ARIC study suggest that the prevalence of arteriolar narrowing and pathological AV crossing seem to be directly related with age. The prevalence of retinopathy was also age-dependent in the Blue Mountains study. As per table no.5,6, the relation between systolic BP, diastolic BP and hypertensive retinopathy was clearly proved in our study. Our data showed that the incidence of hypertensive retinopathy was increasing with increase in Systolic BP, Diastolic BP. BMES, ARIC Studies reported that generalized arteriolar narrowing and pathologic arteriovenous crossings can be observed more commonly in patients with longer duration of diagnosed hypertension, representing signs of chronic vascular damage. On the other hand, focal arteriolar narrowing, retinal hemorrhages, micro aneurysms and cotton wool spots are believed to be related to the current level of hypertension.

The distribution of the severity of Hypertensive retinopathy in this study, according to the classification of Keith, Wagener and Barker was presented as follows:

Grade I - 66 patients (22%),
Grade II - 71 patients (23.7%)
Grade III -4patients (1.3%)
GradeIV – 1 patient(0.3%)

The high frequency of early signs of retinopathy, including grades I and II of Keith-Wagener- Barker, and the low frequency of intense signs, grades III and IV, may be related to the duration of hypertension ,treatment and regular control of blood pressure.[12] There is strong evidence that hypertensive retinopathy signs have a graded and consistent association with blood pressure . In the Beaver Dam Eye Study, hypertensive individuals were 50 to 70 percent more likely to have retinal hemorrhages and micro aneurysms, 30 to 40 percent more likely to have focal arteriolar narrowing, and 70 to 80 percent more likely to have AV nicking than normotensive people. In addition, the Beaver Dam Study showed that persons with uncontrolled hypertension (defined as those whose blood pressure was still elevated despite the use of antihypertensive medications) were more likely to develop retinopathy signs than individuals whose blood pressure was controlled with medications. Data from ARIC and other studies provide evidence that the pattern of associations of blood pressure with specific hypertensive retinopathy signs varies. Generalized retinal arteriolar narrowing and AV nicking appear to be markers of cumulative, long-term hypertension damage, and are independently linked with past blood pressure levels measured five to eight years prior to the retinal assessment.11 In contrast, focal arteriolar narrowing, retinal hemorrhages, micro aneurysms, and cotton wool spots reflect more transient changes of acute blood pressure elevation, and are linked only with concurrent blood pressure measured at the time of the retinal assessment.[13] The ARIC study showed that normotensive participants who had generalized arteriolar narrowing were 60 percent more likely to be diagnosed with hypertension within a subsequent three-year period than normotensive individuals without arteriolar narrowing, independent of pre-existing blood pressure levels, body mass index, and other known hypertension risk factors. According to the computer-assisted programs used in the Atherosclerosis Risk in Communities study, major systemic determinants of narrower arteriolar caliber included past and current higher blood pressure. In a recent follow-up report of the Beaver Dam Eye Study, narrower retinal arteriolar and venular caliber was independently associated with past and current blood pressure. The higher prevalence of retinopathy observed in these studies, compared to the Framingham study, may be due to the higher sensitivity of photographic assessment techniques against ophthalmoscopy. Cuspidi *et al* evaluated 197 patients with grade I and II hypertension (73.0%) without pretreatment, using digital photography combined with angiography, by two independent observers. The overall prevalence of retinal changes was 84.3% and 84.7% respectively.[14] De silva etal in their study suggested the importance of routine mydriatic fundus photography in patients with hypertension and found out that 3% patients required urgent intervention. These findings suggest that a routine retinal examination should be performed among patients with acute ischemic stroke to identify vision threatening retinal diseases.[15] Scanlon PH *et al*. compared two

reference standards in validating two field mydriatic digital photography as a method of screening of retinopathy. As a screening tool, mydriatic fundus camera has good inter-rater reliability with ophthalmoscope (κ=0.90).[16] Couper *et al* conducted a study which suggest that a careful examination of retinal vessels and their changes by retinal photography may be useful for investigating the contribution of small vessel disease to the pathogenesis of cerebrovascular and perhaps other cardiovascular diseases. In our study we observed CRAO in 1 patient(0.3%),NAION in 1(0.3%),Inferior HRVO in 2(0.7%),ITBRVO in 1(0.3%),STBRVO in1(0.3%).No patients were having any other complications like hypertensive optic neuropathy, choroidopathy, vitreous hemorrhage.

In our study the patient who was diagnosed to have NAION had all the recognized risk factors like old age(80yrs), duration of hypertension>14yrs, irregular treatment and presence of uncontrolled hypertension(170/100). Essential arterial hypertension is significantly associated with non-arteritic anterior ischaemic optic neuropathy. Hayreh SS and Zimmerman B in 1999 explained about the role of nocturnal arterial hypotension in optic nerve head ischemic disorders. They suggested that ocular or optic nerve head ischaemic disorders may be due to a combination of systemic arterial hypertension and hypotension. The exact mechanism may be chronic hypoperfusion of the small end-arterial optic nerve head vessels caused by over-treated hypertension or abnormal vascular autoregulation.[17] Out of 4 patients who had vein occlusions, 3 had uncontrolled hypertension and were on irregular treatment. Only one patient with controlled hypertension ,had high lipid levels(TG -250) Sperduto RD *et al* conducted a case control study to identify the risk factors for HRVO. They observed Systemic hypertension and history of Diabetes Mellitus were associated with increased risk of HRVO.[18]Appiah AP, Trempe CL reviewed retrospectively records of 145 consecutive central and 214 branch retinal vein occlusion (CRVO and BRVO) patients. They determine the differences in risk factors associated with branch vs. central retinal vein occlusion. They concluded that Hypertension was significantly more prevalent in BRVO than in CRVO.[19]R Klein, and S E Moss through Beaver Dam Eye Study observed the prevalence and 5-year incidence of retinal vein occlusion using 30 degree color fundus photograph. The prevalence and 5-year incidence of retinal branch vein occlusion were each 0.6%. The prevalence of retinal central vein occlusion was 0.1%, and the 5-year incidence was 0.2% . While adjusting for age, the prevalence of branch vein occlusion was associated with hypertension (odds ratio [OR] 5.42, 95% confidence interval [CI] 2.18, 13.47). They concluded that there exist a strong association between retinal branch vein occlusion and retinal arteriolar changes. In our study CRAO was found in 1(0.3%) patient. Age was 75 years, duration of hypertension was 5yrs.we observed that it was Uncontrolled and he was on irregular treatment. Lipid levels were found to be very high (TG:270) K Rudkin, A W Lee and C S Chen conducted a retrospective audit of consecutive patients with CRAO to assess the Vascular risk factors for central retinal artery occlusion. Hyperlipidemia was the most common undiagnosed vascular risk factor at the time of the sentinel CRAO event (36%). 27% patients had newly diagnosed hypertension or previous diagnosis of hypertension but not optimally controlled.

CONCLUSION

Evaluation of hypertensive retinopathy signs, using digital retinal photography, in hypertensive patients should continue to be part of the guidelines for management of hypertension. We should encourage the use of a "simplified classification" for hypertensive retinopathy in clinical practice because we can easily apply clinically observable signs to stratify patients at risk of cardiovascular disease.

Novel retinal vascular imaging has the potential for noninvasive assessment of the microvascular sequel of hypertension. While currently confined to research settings, this modality may play a clinical role in the future.

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