Original Research Article

Socio demographic determinants of incidence of fundus changes in hypertensive patients

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Abstract

Systemic arterial hypertension is one of the most common diseases of adults in industrialized countries. Although the medical literature subdivides hypertension into multiple groups, only essential (primary) and malignant hypertension are relevant to a discussion of hypertensive retinopathy. 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. Out of 71 patients with uncontrolled hypertension 67 had features of hypertensive retinopathy. Out of 229 patients with controlled hypertension, only 81 had features of hypertensive retinopathy. Out of 3 patients with SBP<120mmHg, 1(33%) had retinopathy. Likewise in group 2, 29(23%) out of 125, in group 3; 36(46%) out of 78, in group 4; 13(59%) out of 22, in group5; 16(94%) out of 17 in group 6; 18(90%) out of 20 in group 7; 35(100%) out of 35 had retinopathy .Mean systolic BP was 135±19.1mm Hg.
Keywords: Socio Demographic Determinants, Fundus Changes, Hypertensive Patients.

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INTRODUCTION

Essential hypertension is the name given to a group of persons whose arterial pressures are raised and in whom no specific disease can be found to account for the raised pressure. It is thus diagnosed by exclusion. Its clinical manifestation represents the consequences of raised arterial pressure on the cardiovascular system. The end stages of essential hypertension are a comparatively uniform malignant course dominated by fibrinoid necrosis of arterioles, and much more benign course in which other vascular lesions play a dominant role.

Systemic arterial hypertension is one of the most common diseases of adults in industrialized countries. Although the medical literature subdivides hypertension into multiple groups, only essential (primary) and malignant hypertension are relevant to a discussion of hypertensive retinopathy. Globally, the overall prevalence of raised blood pressure in adults aged 25 and over was around 40%. Blacks have a higher prevalence of hypertension than whites, and men are affected more than women. However, over age 50, women have a higher prevalence than men.[1] Elevated blood pressure is rare in individuals who are physically active. The incidence of hypertensive retinal changes is variable and is often confounded by the presence of other retinal vascular disease, such as diabetes. In the Beaver Dam Eye Study, which evaluated hypertensive patients without coexisting, confounding vascular diseases, the overall incidence of hypertensive retinopathy was about 15%; specifically, 8% showed retinopathy, 13% showed arteriolar narrowing, and 2% showed arteriovenous nicking. The predictive value of diagnosing systemic hypertension from ophthalmic findings on examination was only 47–53%, demonstrating that measurement of blood pressure is a more accurate means of diagnosis. The highest frequency of hypertensive

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retinopathy in the study population was identified in subjects with poor blood pressure control.[2]

Hypertensive retinopathy is a condition characterized by a spectrum of retinal vascular signs in elevated blood pressure and was first described by Liebreich in1859. The detection of hypertensive retinopathy with the use of an ophthalmoscope has been regarded as part of standard evaluation of patients with hypertension. The clinical practice is supported by both previous and current reports of the Joint National Committee on Prevention, Detection, evaluation and treatment of High blood pressure, which list retinopathy as a marker of target organ damage in hypertension. On the basis of JNC criteria, the presence of retinopathy may be an indication for initiating anti hypertensive treatment, even in people with stage 1 hypertension who have no other evidence of target organ damage.[3]

Erden S and Bicakci E in 2012 found that age, duration of hypertension, and systolic blood pressure levels were significant risk factors for retinopathy. They observed that the degree and duration of hypertension increases the incidence of retinopathy. Low-grade retinopathy seems not to be associated with other cardiovascular risks.

The retinal circulation undergoes a series of pathophysiological changes in response to elevated blood pressure.[4]In the initial vasoconstrictive phase there is vasospasm and an increase in retinal arteriolar tone owing to local autoregulatory mechanisms. This stage is seen clinically as generalized narrowing of retinal arterioles. Persistently elevated blood pressure leads to intimal thickening, hyperplasia of the media wall and hyaline degeneration in the subsequent sclerotic stage. This stage corresponds to more severe generalized and focal areas of arteriolar narrowing, changes in the arteriolar and venular junctions(arteriovenous nicking or nipping) and alterations in the arteriolar light reflex(widening and accentuation of the central light reflex or “copper wiring”)

This is followed by an exudative stage, in which there is disruption of the blood retinal barrier, necrosis of smooth muscles and endothelial cells, exudation of blood and lipids, and retinal ischemia. These changes are manifested in the retina as micro aneurysms, hemorrhages, hard exudates and cotton wool spots.

Swelling of the optic disc may occur at this time and usually indicates severely elevated blood pressure (malignant hypertension).Malignant hypertension is rarely seen in the general population because better methods for the control of blood pressure are now available .In contrast, other retinal vascular complications of hypertension such as macro aneurysms and branch vein occlusions, are not uncommon in patients with chronically elevated blood pressure. The stages of hypertensive retinopathy described ,however may not be sequential. For example ,signs of retinopathies that reflect the exudative stage such as retinal hemorrhage or microaneurysms, may be seen in the eyes that do not have features of the sclerotic stage (eg: arteriovenous nicking)[5]. The exudative signs are nonspecific since they are seen in diabetes and other conditions.

METHODOLOGY

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.

RESULTS

Table 1: Sex wise distribution of hypertensive patients

SEX	NUMBER	PERCENTAGE
Females	149	**49.7**
Males	151	**50.3**
Total	**300**	**100.0**

Table 2: Distribution of cases Duration wise

	No of years	Number	Percentage	Patients with retinopathy		Patients without retinopathy	
				%	No.	%	No.
1	<1yr	22	**7.3**	**3.4**	**5**	**11.2**	**17**
2	1Yr-4yr 11m	152	**50.7**	**27.3**	**41**	73	111
3	5Yrs-9yrs11m	77	**25.7**	**37.5**	**55**	**14.5**	**22**
4	10Yrs-14yrs11m	36	**12.0**	**23**	**34**	**1.3**	**2**
5	>15Yrs	13	**4.3**	**8.8**	**13**	**0**	**0**
Total		**300**	**100.0**	**100**	**148**	**100**	**152**

Out of 300 patients, 22 (7.3%) were in group 1, 152 (50.7%) in group 2, 77(25.7%) in group 3, 36(12%) in group 4 and 13(4.3%) in group 5. Out of these patients, in Group 1, 5(3.4 %), 41(27.3%) in group 2, 55(37.5%) in group 3, 34 (23%) in group4 and13 (8.8%) in group 5 had positive findings. From this data using Chi Square test $p<0.05$ the association between duration of hypertension and incidence of hypertensive retinopathy was found to be statistically significant.

Table 3: Showing distribution of cases according to Systolic BP

			RETINOPATHY		
Systolic BP			PRESENT	ABSENT	Total
	<120	Number	1	2	3
		%	**.7%**	**1.3%**	**1.0%**
	120-129	Number	29	96	125
		%	19.6%	63.2%	41.7%
	130-139	Number	36	42	78
		%	**24.3%**	**27.6%**	**26.0%**
	140-149	Number	13	9	22
		%	**8.8%**	**5.9%**	**7.3%**
	150-159	Number	16	1	17
		%	**10.8%**	**.7%**	**5.7%**
	160-169	Number	18	2	20
		%	**12.2%**	**1.3%**	**6.7%**
	170-200	Number	35	0	35
		%	**23.6%**	**.0%**	**11.7%**
	Total	Number	148	152	300
		%	**100.0%**	**100.0%**	**100.0%**

Out of 3 patients with SBP<120mmHg, 1(33%) had retinopathy. Likewise in group 2, 29(23%) out of 125, in group 3; 36(46%) out of 78, in group 4; 13(59%) out of 22, in group5; 16(94%) out of 17 in group 6; 18(90%) out of 20 in group 7; 35(100%) out of 35 had retinopathy .Mean systolic BP was 135±19.1mm Hg. Standard error of mean was 1.10.

Table 4: Showing distribution of cases according to Diastolic BP

			RETINOPATHY		
Diastolic BP			PRESENT	ABSENT	Total
	<80	Number	5	14	19
		%	**3.4%**	**9.2%**	**6.3%**
	80-89	Number	57	129	186
		%	**38.5%**	**84.9%**	**62.0%**
	90-99	Number	42	8	50
		%	**28.4%**	**5.3%**	**16.7%**

	100-109	Number	39	1	40
		%	**26.4%**	**.7%**	**13.3%**
	>110	Number	5	0	5
		%	**3.4%**	**.0%**	**1.7%**
	Total	Number	148	152	300
		%	**100.0%**	**100.0%**	**100.0%**

Our data shows that out of 19 patients with DBP<80mmHg, 5(35%) were having retinopathy. In the same way in group 2, 57(30.6%) out of 186, 42(84%) out of 50 in group 3, 39(97.3%) out 0f 40 in group 4 and 5 (100%) out of 5 in group 5 had retinopathy. Mean Diastolic BP is 84.76±8.516mmHg. Standard error of mean is 0.492. From this data the association between severity of hypertension and incidence of retinopathy is proved using Chi square test. ($p<0.05$)

Table 5: Showing distribution of cases with co morbidities

		FUNDUS		
		POSITIVE FINDINGS	**NORMAL**	**Total**
CKD	Number	1	0	1
	%	**.7%**	**.0%**	**.3%**
CKD,IHD	Number	1	0	1
	%	**.7%**	**.0%**	**.3%**
IHD	Number	7	0	7
	%	**4.7%**	**.0%**	**2.3%**
NIL	Number	139	152	291
	%	**93.9%**	**100.0%**	**97%**
Total	Number	148	152	300
	%	**100%**	**100 %**	**100%**

Out of the cases examined, 1 (0.33%) had CKD, 1(0.33%) had CKD with IHD, 7(2.3%) had IHD. 291(97%) patients were found to have no other co morbidities. All the patients with these co morbidities had features of hypertensive retinopathy. So using Chi-square test the association between other diseases and fundus changes in hypertension is found to be statistically significant. ($p <0.05$)

Table 6: Distribution of Regular treatment among patients

			Fundus		
Regular treatment			**Positive findings**	**Normal**	**Total**
	NO	Number	58	3	61
		%	**39.2%**	**2.0%**	**20.3%**
	YES	Number	90	149	239
		%	**60.8%**	**98.0%**	**79.7%**
	Total	Number	148	152	300
		%	**100.0%**	**100.0%**	**100.0%**

Out of the 300 cases examined, 239(79.7%) took regular treatment .In those patients who took regular treatment ,149(98%) of the patients were not having any features of hypertensive retinopathy.Out of the patients who were on irregular treatment ,only 3 (2%) were found to be normal. OR(Odds ratio)=32 Using Fischer Extract test the association between regular treatment and incidence of hypertensive retinopathy was found to be statistically significant.

Table 7: Distribution of smoking among patients

		FUNDUS		
		POSITIVE	**NORMAL**	**Total**
NIL	Number	95	117	212
	%	**64.2%**	**77.0%**	**70.7%**
SMOKER	Number	53	35	88
	%	**35.8%**	**23.0%**	**29.3%**
Total	Number	148	152	300
	%	**100 %**	**100 %**	**100 %**

212(70.7%) patients were non smokers and 88(29.3%) were smokers. Among the smokers 53(35.8%) were found to have features of hypertensive retinopathy. Among the non smokers 95(64.2%) were found to have features of hypertensive retinopathy. OR-0.5 Even though the association between smoking and hypertensive retinopathy is statistically significant $p<0.05$ a causal relationship was not established.

Table 8: Distribution of alcohol consumption among patient

		FUNDUS		
		POSITIVE	NORMAL	Total
ALCOHOL	Number	20	5	25
	%	**13.5%**	**3.3%**	**8.3%**
NIL	Number	128	147	275
	%	**86.5%**	**96.7%**	**91.7%**
Total	Number	148	152	300
	%	**100%**	**100%**	**100%**

Out of 300 patients, 25 (8.3%) patients used to consume alcohol. Among these alcoholic patients 20 (80%) patients had features of hypertensive retinopathy. OR=4.5 Using Fischer extract test the association between alcohol consumption and hypertensive retinopathy is found to be statistically significant. ($p<0.05$).

Table 9: Distribution of controlled hypertension among patients

			FUNDUS		
			POSITIVE	NORMAL	Total
CONTROLLED HYPERTENSION	NO	Number	67	4	71
		%	**45.3%**	**2.6%**	**23.7%**
	YES	Number	81	148	229
		%	**54.7%**	**97.4%**	**76.3%**
	Total	Number	148	152	300
		%	**100%**	**100%**	**100%**

Out of 71 patients with uncontrolled hypertension 67 had features of hypertensive retinopathy. Out of 229 patients with controlled hypertension, only 81 had features of hypertensive retinopathy. From the above data using the Chi Square test, the association between hypertensive retinopathy and controlled hypertension is found to be highly significant.($p<0.05$)

Table 10: Distribution of Positive family history among cases

		FUNDUS		
FAMILY HISTORY		POSITIVE	NORMAL	Total
ABSENT	Number	67	69	136
	%	**45.3%**	**45.4%**	**45.3%**
PRESENT	Number	81	83	164
	%	**54.7%**	**54.6%**	**54.7%**
Total	Number	148	152	300
	%	**100.0%**	**100%**	**100%**

Out of 148 patients with retinopathy, family history was present in 81(54.7%) patients and absent in 67(45.3%).Using Chi square test the association between family history and hypertensive retinopathy is found to be not statistically significant.

Table 11: Distribution of risk factors among the patients with retinopathy

RISK FACTOR	PRESENT	ABSENT	TOTAL
Smoking			
Number	53	35	88
%	60.2 %	39.8 %	100%
Alcohol			
Number	20	5	25
%	80 %	20%	100 %
Uncontrolled HTN Number			
%	67	4	71
	94. 4%	5.6%	100 %
Irregular Treatment			
Number	58	3	61

%	95.1 %	4.9 %	100 %
Family History			
Number	81	83	164
%	49.4 %	50.6 %	100 %

DISCUSSION

In our study, 98% of the patients who took regular treatment , were not having any features of hypertensive retinopathy. Among 152 patients with normal fundus study 148(97.4%) were having controlled hypertension. According to our data irregular treatment (OR=32) and uncontrolled hypertension(OR=30.61) were found to be strong risk factors. The study conducted by Mayuri and Wong had shown in the hypertensive population, patients with elevated blood pressure despite medical therapy had a higher frequency of retinopathy signs, compared with those whose blood pressure was controlled or those who were normotensive. This finding indicates that hypertensive retinopathy signs may be an indicator of blood pressure control.[6] Wong *et al* through CHS study concluded that among hypertensive people, those whose BP was uncontrolled despite treatment or who were not on treatment were more likely to have retinal microvascular lesions than those with good BP control. In the Beaver Dam Eye Study, non-diabetic people aged 43–84 years with untreated or uncontrolled hypertension were found to have focal arteriolar narrowing, arteriovenous nicking, and retinopathy than those with hypertension with adequate BP control.[8] In the Blue Mountains Eye Study, non-diabetic people aged 49 years and older with untreated or uncontrolled hypertension were more likely to have retinopathy than those with controlled hypertension. Since retinal microvascular lesions are correlated with end organ damage elsewhere and independently predict stroke, these data further support the importance of appropriate BP control in reducing hypertensive associated complications.[9] Our study indicates consistent associations across the whole spectrum of retinal microvascular signs for persons with either untreated or uncontrolled hypertension. Our study was in coherence with the above studies. Although we used photographs to grade focal arteriolar narrowing and AV nicking, the methodology in assessing these retinal microvascular signs is relatively subjective. In our study 70.7% of patients were nonsmokers and in them 64.2% were affected. Through our study we could not establish a direct causal relationship between smoking and severity of hypertensive retinopathy(OR=0.5).The reason for this may be inclusion of more number of females in the study who were found to be non smokers. Poulter, Neil R. observed that both cigarette smoking and hypertension cause adverse cardiovascular events. Furthermore, these two major risk factors appear to act synergistically when they coexist Amongst many acute adverse effects , smoking a cigarette causes blood pressure to rise acutely and smoking has been causally linked with malignant hypertension.[10] The true association between smoking and arterial pressure is difficult to assess, not least because of the short-term acute effects of smoking on blood pressure, which are not usually incorporated into measurements recorded in the clinical setting. This situation is further complicated by the complex inter-relationships between smoking, obesity, alcohol intake, other dietary variables, physical activity and socio-economic status, all of which are associated with both smoking and variability in blood pressure levels. These inter-relationships differ between men and women. The findings of this latest study suggest that, after suitable adjustment, current smoking, particularly in older men, is associated with an increased risk of systolic but not diastolic hypertension. Virdis A *et al* observed that Hypertensive smokers are more likely to develop severe forms of hypertension, including malignant and renovascular hypertension, an effect likely due to an accelerated atherosclerosis. Though the true association between smoking, hypertension and target-organ damage is difficult to assess due to the confounding effects of other life-style and socio-economic factors, studies focusing on malignant hypertension have shown a strong association between smoking and grade IV hypertensive retinopathy.[11] In our study 25(8.3%) patients used to consume alcohol. Among them 20 were found to have features of hypertensive retinopathy. Alcohol was proved to be a risk factor in our study(OR=4.59). According to the observations made by Mayuri Bharghava and Wong heavy alcohol consumption was associated with narrower retinal arteriolar diameters, which are the earliest changes in hypertensive retinopathy.[8] As per table no.7,in our study 9(3%) patients had co morbidities like CKD, IHD, CKD and IHD. Out of the 7 patients with IHD,4 had grade II Hypertensive retinopathy,2 had grade I and one had grade III. The patient with CKD had grade IV retinopathy and the patient with CKD and IHD had grade III Retinopathy. All these patients had features of hypertensive retinopathy. We found a statistically significant association between other diseases and incidence of fundus findings. The fundal changes help in prognosis of systemic hypertensive complications as seen in the population based cross sectional study conducted by Tien Yen Ying *et al*; CHD (Odd's Ratio 1.7), MI (OR 1.7), stroke (OR 2.0), carotid artery plaque (OR 1.9), glomerulosclerosis and silent brain infarction (defined as 3mm lesions in standard imaging of

the brain tissue; p = 0.001) The ARIC study reported that after controlling for pre-existing risk factors, individuals with retinal hemorrhages, micro aneurysms, and cotton wool spots were twice as likely to develop congestive heart failure than individuals without retinopathy. In fact, even among individuals considered at low risk of heart failure (those without pre-existing coronary heart disease, diabetes or hypertension), the presence of hypertensive retinopathy signs predicted a three-fold increased risk of heart failure events. Duncan *et al* demonstrated that the presence of hypertensive retinopathy in men doubled the chance of ischemic heart disease. ARIC study reported a correlation between generalized arteriolar narrowing and ischemic heart disease in women but not in men. There have been studies showing associations of various hypertensive retinopathy signs with coronary artery stenosis on angiography, and with incident coronary heart disease and myocardial infarction. It has long been known that in persons with untreated hypertension, hypertensive retinopathy signs are indicators of mortality.[12] In Beaver Dam Eye Study, individuals with retinal micro aneurysms and retinal hemorrhages were twice as likely to die from cardiovascular events as those without these signs. CRIC Study suggests that retinal vascular pathology may be indicative of macrovascular disease, and that the assessment of retinal morphology may be a valuable tool in studies of CVD in chronic kidney disease. Results from CRIC study showed a strong association between the severity of retinopathy observed in eye fundus photographs and kidney function. This association, suggested that retinal vascular pathology may reflect renal disease.

CONCLUSION

The relationship between magnitude, duration of hypertension and severity of retinopathy is well established in the study ($p<0.05$).Uncontrolled hypertension and irregular treatment were found to be strong risk factors.

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