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ORIGINAL ARTICLE

Retinal Microvascular Changes in Patients with Stroke

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Abstract

Introduction: Stroke is a common manifestation of cerebrovascular disease. The common risk factors for stroke include hypertension and diabetes mellitus. Retinal and cerebral vessels have common embryological and anatomical characteristics; thus, they show similar patterns of damage from diseases. Therefore, examination of the fundus could provide a noninvasive view of intracranial vascular pathology. ***Purpose:*** To examine the fundus of patients presenting with acute stroke to see prevalence of retinal findings and their correlation with stroke. ***Material and Methods:*** This observational cross-sectional study was carried out among 50 patients with acute stroke presenting to medicine emergency of tertiary care teaching hospital in North India. Detailed medical history was taken and complete general physical examination was performed. Fundus was examined with the help of direct and indirect ophthalmoscopy. Data was analyzed with online software OpenEpi version 3. Chi square test was applied and p values <0.05 were considered statistically significant. ***Results:*** The mean age in this study was 63.9 ± 13.8 years with male to female ratio of 3.16:1. There was a significant association between vessel attenuation, arterio-venous (AV) changes, hemorrhages, hard exudates and cotton spots among hypertensive patients with stroke (*p* value <0.05). Among the diabetic patients, AV changes, hemorrhages, hard exudates, cotton wool spots and neovascularization were significantly associated with stroke (*p* value <0.05). ***Conclusions:*** Therefore, routine retinal examination is important in patients with stroke. Presence of retinal findings act as marker for underlying diseases such as hypertension and diabetes, providing risk stratification among individual patients.

Key Words

Stroke, Hypertension, Diabetes mellitus, Retina

Introduction

Stroke is a major public health problem. Stroke was the second leading cause of death worldwide (1). Subsequent studies reported 5.87 million deaths due to stroke in 2010 (2). The cumulative incidence of stroke in India ranges from 105 to 152/100,000 persons per year (3).

Stroke is the most common manifestation of cerebrovascular disease. The presenting features include unilateral weakness, speech disturbances, visual deficit, visuo-spatial dysfunction, ataxia, headache and seizure. The common risk factors for stroke include hypertension and diabetes mellitus (4). Hypertension causes

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microvascular damage in both the cerebral and retinal circulations. Retinal and cerebral vessels have common embryological and anatomical characteristics; thus, they may also show similar patterns of damage from diseases such as hypertension. Studies have shown that one third patients with diabetes have increased risk of systemic vascular diseases like stroke, coronary artery disease and heart failure (5). Therefore, examination of the fundus could provide a noninvasive view of intracranial vascular pathology.

Fundus findings in hypertension include focal and generalized arteriolar narrowing, arterio-venous nicking, flame shaped and dot blot hemorrhages, cotton wool spots, hard exudates, disc edema and retinal vascular occlusions. On the other hand, findings in diabetes include microaneurysms, flame shaped and dot blot hemorrhages, hard exudates, cotton wool spots, venous beading, intra-retinal microvascular abnormalities and macular edema (6).

Thus, there is a need to examine the fundus of patients with risk factors for stroke such as hypertension and diabetes. In view of the risk profile of stroke, we examined the fundus of patients presenting with acute stroke to see prevalence of retinal findings and their correlation with stroke, which will help us in appropriate neurological and ophthalmological referral and proper management of patients.

Material and Methods

The present hospital based observational cross-sectional study was conducted over a period of six months from September 2019 to March 2020 in tertiary care teaching hospital in North India. This study included 50 patients with acute stroke presenting to medicine emergency of tertiary care hospital. Patients who fulfilled the following criteria were included in the study and informed consent was taken from each patient after explaining the purpose of the study. Ethical clearance was taken from institutional ethics committee.

Inclusion criteria: Patients with age >18 years presenting with acute stroke to medicine emergency.

Exclusion criteria: i) Unconscious patients; ii) Patients with history of ocular trauma; iii) Individuals presenting after 1 year of symptom onset; iv) Patients with history of intra-cranial space occupying lesion; v) Patients with history of blood dyscrasias; and vi) Patients with neurodegenerative disorders.

A detailed medical history was taken and complete general physical examination was performed. Pupillary dilation was performed with 0.8% tropicamide and 2.5% phenylephrine eye drops. Fundus was examined with the help of direct and indirect ophthalmoscopy. Stroke was diagnosed by neurologist based on clinical features, physical signs and radiological imaging. Hypertension was diagnosed by physician according to JNC 8 guidelines. Diabetes was diagnosed by physician based on fasting and post-prandial blood sugar levels, use of insulin and oral hypoglycemic drugs.

Statistical analysis: All data was entered in Microsoft excel and subsequently analysed with online software OpenEpi version 3. Chi square test was applied and *p* values <0.05 were considered statistically significant. All *p*-values used were two tailed.

Results

The mean age in this study was 63.9 ± 13.8 years with age range of 42-100 years (*Table1*). There were 38 (76%) males and 12 (24%) females (*Figure 1*). There were 36 (72%) cases of ischemic stroke and 14 (28%) cases of hemorrhagic stroke (*Figure 2*). 27 (56%) patients had hypertension and 16 (32%) patients had diabetes mellitus.

Fundus findings were present in 43 (86%) patients. Among these findings, age related macular degeneration

Table 1: Age Distribution of Patients

Age (in years)	Number	Percentage
40-50	7	14%
51-60	5	10%
61-70	15	30%
71-80	13	26%
81-90	9	18%
91-100	1	2%
Total	50	100%

Table 2: Fundus Findings in Patients with Stroke

Findings	Number	Percentage
Vessel attenuation	13	26%
AV changes	17	34%
Haemorrhages	12	24%
Hard exudates	5	10%
Cotton wool spots	10	20%
ARMD	16	32%
Disc pallor	1	2%
Retinal pigmentary changes	1	2%
BRVO	1	2%
Neovascularisation	2	4%

AV=Arteriovenous; ARMD=Age related macular degeneration; BRVO=Branch retinal vein occlusion

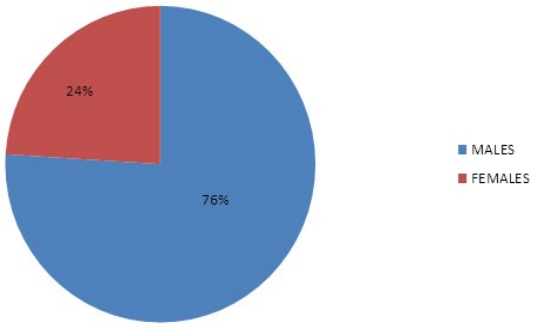

Figure 1: Gender Distribution of Patients

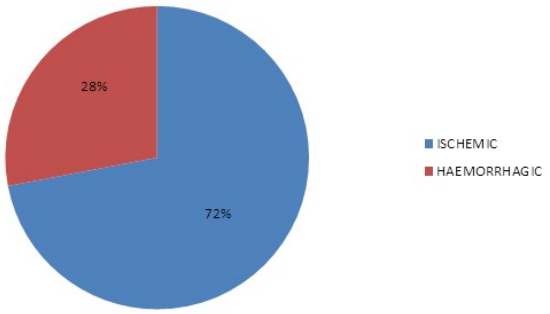

Figure 2: Type of Stroke in Patients

Table 3: Correlation of Fundus Findings in Hypertension and Diabetes with Stroke

	Hypertension			Diabetes Mellitus		
	Yes	**No**	***p* value**	**Yes**	**No**	***p* value**
Vessel attenuation	13	0	**0.02***	8	5	0.10
AV changes	17	0	**0.00***	13	4	**0.001***
Hemorrhages	12	0	**0.03***	10	2	**0.001***
Hard exudates	5	0	**0.04***	5	0	**0.002***
Cotton wool spots	10	0	**0.03***	9	1	**0.000***
ARMD	10	6	0.50	4	12	0.50
Neovascularisation	0	2	0.10	2	0	0.04
BRVO	1	0	0.30	0	1	0.10

*=Significant; AV=Arteriovenous; ARMD=Age related macular degeneration, BRVO=Branch retinal vein occlusion

was most common, present in 16 (32%) patients followed by arterio-venous changes in 17 (34%) patients and retinal vessel attenuation in 13 (26%) patients. 12 (24%) patients had retinal haemorrhages. Other findings included cotton wool spots, hard exudates, neovascularisation and branch retinal vein occlusion (BRVO). One patient had pale waxy disc and retinal pigmentary changes (*Table 2*).

Correlation between retinal findings in patients with hypertension and diabetes with stroke is shown in *Table 3*. There was a significant association between vessel attenuation, AV changes, hemorrhages, hard exudates and cotton spots among hypertensive patients with stroke (p value <0.05). Among the diabetic patients, AV changes, hemorrhages, hard exudates and cotton wool spots were significantly associated with stroke (p value <0.05) (*Table 3*).

Discussion

The mean age in our study was 63.9 ± 13.8 years which is similar to findings by Uhumwangho *et al.* (7) who reported mean age of 66.1 ± 11.0 years. De Silva *et al.* (8) reported mean age of 65 years whereas Abah *et al*. (9) reported mean age of 58.8 ± 7.7 years. The prevalence of retinal findings was found to be 86% in our study, whereas Abah *et al.* (9) found prevalence of retinal findings to be 57.4% and De Silva *et al.* (8) reported prevalence to be 59%.

There were 76% males and 24% females in our study. This is similar to findings by Uhumwangho *et al.* (7) who reported 61 males (71.8%) and 24 females (28.2%) in their study. Whereas in study by Abah *et al*. (9) there were 59.6% males and 40.4% females, and in study by De Silva *et al*. (8) there were 58% males and 42% females.

In our study, 56% patients had hypertension and 32% patients had diabetes mellitus. This is similar to studies by Abah *et al*. (9) who reported 64% hypertensive and 36% diabetic patients, and De Silva *et al.* (8) who reported 69% hypertensive and 59% diabetic patients. Uhumwangho *et al.* (7) in their study reported 95.3% hypertensive and 36.5% diabetic patients. There were 72% cases of ischemic stroke and 28% cases of haemorrhagic stroke in our study whereas Uhumwangho *et al.* (7) reported 78.8% cases of ischemic stroke and

21.2% cases of hemorrhagic stroke.

Retinal findings in our study were similar to Abah *et al.* (9) who reported ARMD in 36% cases, cotton wool spots in 22.2% cases, hard exudates in 12.7% cases, neovascularisation in 5% cases and BRVO in 1.9% cases. They reported retinal hemorrhages in 16.5% cases which is less than that reported in our study. De Silva *et al.* (8) in their study reported ARMD in 30% cases, retinal hemorrhages in 27% cases, cotton wool spots in 11% cases, hard exudates in 7% cases and neovascularisation and BRVO in 1% cases.

There was significant association of retinal manifestations such as vessel attenuation, AV changes, hemorrhages, hard exudates and cotton wool spots in hypertensive patients with stroke (p value <0.05). None of these findings were present in non-hypertensive patients except ARMD (12%). Among the diabetic patients, AV changes, hemorrhages, hard exudates, cotton wool spots and neovascularisation were significantly associated with stroke (p value <0.05). Studies have shown that most retinal microvascular characteristics were predictive of incident stroke, with adjusted relative risks of 2.58 for any retinopathy, 3.11 for microaneurysms, 3.08 for soft exudates, 2.55 for blot haemorrhages, 2.26 for flame-shaped haemorrhages, and 1.60 (1.03-2.47) for arteriovenous nicking (10).

Thus, retinal manifestations occur in stroke patients as a manifestation of underlying medical condition such as hypertension and diabetes mellitus (11-15). Therefore, routine retinal examination is advised in patients with stroke. The retinal vessel pathology serves as an important marker for stratification of patient's risk for having or developing cerebrovascular disease (16). The presence of retinal findings could help in making an appropriate referral to neurologist, thereby preventing the morbidity and mortality associated with stroke (17-19).

Limitations: Investigations like Optical coherence tomography, fundus fluorescein angiography and fundus photography were not utilized, which may have helped in picking up more retinal pathologies and would have eliminated inter-observer bias.

Conclusion

We conclude that routine retinal examination is important in patients with stroke. Presence of retinal findings act as marker for underlying diseases such as hypertension and diabetes, which provides risk stratification in individual patients and hence appropriate and timely referral to neurologist.

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Conflicts of Interest
There are no conflicts of interest.

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