Relation between Retinal Arterial Occlusions in the Eye and Carotid Artery Occlusion - A Retrospective Study in a Tertiary Care Hospital in Kottayam in Kerala

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ABSTRACT

BACKGROUND

Central retinal artery occlusion (CRAO) was first described by Van Graefe in 1859 as an embolic event to the central retinal artery in a patient with endocarditis. CRAO has various causes, but patients typically present with sudden, severe, and painless loss of vision. Retinal arterial occlusions are a cause for profound visual loss in the population. Carotid atherosclerosis is common in elderly people. Dyslipidaemia, hypertension, and diabetes mellitus are factors which accelerate the development of carotid atheromatous plaques. Embolism from the carotid bifurcation is the most common cause of retinal artery occlusions. In retinal arterial occlusion carotid arterial occlusion is usually assessed using radiological techniques. The purpose of this study was to evaluate carotid atherosclerotic disease in patients with arterial occlusions in the eye and determine the relation between arterial occlusions in the eye & carotid artery occlusive disease.

METHODS

This retrospective study included patients aged thirty and above, who had come with symptoms suggestive of arterial occlusions in the eye and carotid doppler was done. The inclusion criteria included patients diagnosed with the following conditions CRAO, branch retinal artery occlusion (BRAO), ophthalmic artery occlusion, anterior ischaemic optic neuropathy (AION) and cilioretinal artery occlusion. Patients usually present with sudden loss of vision in one eye. After taking a detailed history, all patients were subjected to a thorough ocular examination. Patient's vision is assessed using Snellen's visual acuity chart, pupillary assessment done, and fundus examination to look for retinal arterial occlusion is also done. Fundus imaging is also done. Carotid doppler was done to rule out carotid artery occlusive disease.

RESULTS

Patients presenting with retinal arterial occlusion should be investigated thoroughly for both systemic and local causes of CRAO. The risk of developing arterial occlusions were 1.7 - 9.15 times more in patients with carotid artery occlusion than in patients with normal carotids. Arterial occlusion was more found in patients with 70 % occlusion of the carotid artery.

CONCLUSIONS

There was a strong association between retinal arterial occlusions and carotid artery occlusion.

KEYWORDS

Central Retinal Artery Occlusion (CRAO), Carotid Artery Occlusive Disease, Carotid Doppler

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BACKGROUND

Retinal arterial occlusions are a cause for profound visual loss in the population. Since ophthalmic artery is the first branch of internal carotid artery, diseases of the internal carotid artery significantly affects the eye. Retinal blood flow is regulated by both autonomic and local metabolic factors especially the demand for oxygen. So, any factors which disrupt the controlling factors can disrupt the retinal blood flow. Arterial occlusions in the eye are also related to various systemic diseases like hypertension, diabetes, ischemic heart disease, atherosclerosis etc.[1-6]

Embolism from the carotid bifurcation is the most common cause of retinal artery occlusions. Types of carotid emboli are cholesterol, fibrinoplatelet, calcified and cardiac emboli. CRAO, ophthalmic artery occlusion and cilioretinal artery occlusion presents with sudden profound painless loss of vision. AION presents with painful loss of vision, while optical image stabilizer (OIS) presents with chronic progressive loss of vision.[7-10]

It has been described that embolism from the carotid bifurcation is the most common cause of retinal artery occlusions. Types of carotid emboli are cholesterol, fibrinoplatelet, calcified and cardiac emboli. CRAO, ophthalmic artery occlusion and cilioretinal artery occlusion presents with sudden profound painless loss of vision. AION presents with painful loss of vision, while OIS presents with chronic progressive loss of vision

Patients presenting with retinal arterial occlusion should be investigated thoroughly for both systemic and local causes. Recently it has been shown that carotid ultrasonography may provide accurate information regarding both arterial lumen narrowing and plaque morphology. Ultrasonography is a simple, non-invasive technique which can be easily done on any kind of patients. All patients with arterial occlusion in the eye should be subjected to bilateral carotid ultrasound.[11-17] If arterial occlusion has occurred in one eye, bilateral carotid ultrasonography can predict the occurrence of the same in the other eye. If the carotid disease is diagnosed at the right time, further complications like arterial occlusion in the other eye, stroke etc. can be prevented by medication and modification of systemic risk factors.[18-21] Carotid occlusive disease may predispose the patient to various thromboembolic episodes like stroke, transient ischaemic episodes. Development of atherosclerosis in carotid arteries may cause thrombus formation locally which will generate the emboli. The emboli may get dislodged from there and may get stationed in any of the distributive areas of carotid artery. So, the emboli may come to the carotid artery and hence to the retinal artery. Embolism from the carotid bifurcation is the most common cause of retinal artery occlusions. There was a strong association between retinal arterial occlusions and carotid artery occlusion. In retinal arterial occlusion, carotid arterial occlusion is usually assessed using radiological techniques.

The purpose of this study was to evaluate carotid atherosclerotic disease in patients with arterial occlusions in the eye and to determine the relation between arterial occlusions in the eye & carotid artery occlusive disease.

METHODS

This retrospective study included patients aged thirty and above, who had come to the outpatient department (OPD) of a tertiary care hospital in Kottayam in Kerala with symptoms suggestive of arterial occlusions in the eye, over a period of one year from June 2008 to June 2009. Both indoor and OPD patients were included in the study. Males and females coming from both urban and rural areas were included in the study. Documentation of detailed history of patient's symptoms together with age and sex was taken. In history taking, special reference was given to presence of symptoms like sudden loss of vision, pain, field defect, defective colour vision. Systemic diseases like hypertension, diabetes, hypercholesterolemia, ischemic heart disease were asked for.

After a formal vision testing and refraction, patients were subjected to anterior segment slit lamp examination. A dilated fundus examination was done with direct and indirect ophthalmoscope and 90D lens. For identification of risk factors, routine blood examination and fasting lipid profile was done. Carotid doppler was done to rule out any carotid artery occlusive disease. It was done using no: 7 vascular probe in a longitudinal and transverse plane from anterior and lateral aspect. The inclusion criteria included patients diagnosed with the following conditions CRAO, BRAO, ophthalmic artery occlusion, AION and cilioretinal artery occlusion. Data was collected from patients admitted in the ward with arterial occlusion in the eye. Carotid doppler was done in all patients to find out the relationship between carotid artery occlusive disease and arterial occlusion in the eye. Informed consent was taken from each patient before he/she was included in the study. After taking a detailed history, all patients were subjected to a through ocular examination.

The exclusion criteria included patients less than the age of thirty, history of glaucoma, intraocular inflammation and trauma. 50 patients and 50 controls were included in the study. Sample technique used: $n = (Z_{\alpha} + Z_{2\beta})^2 \{1 - \sqcap_1) + \sqcap_2(1 - \sqcap_2)\}/ó^2$ Where n is the sample size, $\sqcap_1$ = proportion of carotid occlusion in control group, $\sqcap_2$ = proportion of carotid occlusion in study group, ȯ = $\sqcap_2$ - $\sqcap_1$, ɑ = .05, β =.8. Data was collected from patients with arterial occlusion in the eye. Carotid doppler was done in all patients to find out the relationship between carotid artery occlusive disease and arterial occlusion in the eye. Informed consent was taken from each patient before he/she was included in the study. After taking a detailed history, all patients were subjected to a through ocular examination.

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Statistical Analysis

Data was analysed using statistical software package,

statistical package for social sciences (SPSS) software. The statistical significance of differences in the frequencies was assessed by X^2 test. P value was calculated, and significance of results was analysed. Odds ratio and confidential interval were calculated and strength of association of variables were noted. Logistic regression was calculated, and result was obtained.

Logistic regression analysis was performed on the statistically significant variables namely hypertension, fasting lipid profile (FLP) & CD in the model. The odds ratio of risk factors is statistically significant. They together account for 34.1 % of variation in the disease. When each variable is taken into account, abnormal FLP accounts for 17 % of variation of disease, HT accounts for 80 % of variation of disease and CD accounts for about 16 % of variation of disease.

Type of Retinal Arterial Occlusion	Frequency	Percentage
CRAO	23	46.0
NAION	14	28.0
BRAO	5	10.0
Cilioretinal artery occlusion	3	6.0
OIS	3	6.0
Ophthalmic artery occlusion	2	4.0
Total	**50**	**100.0**

Table 1. Type of Retinal Artery Occlusion in the Study Group

RESULTS

Of 100 subjects studied, maximum number of patients were between the age group of 51 - 60. P value was not significant, i.e., study group and control group are comparable. There were 30 males and 20 females in the study group, while there were 32 males and 18 females in the control group. P value was > 0.05, i.e., it was statistically not significant and comparable.

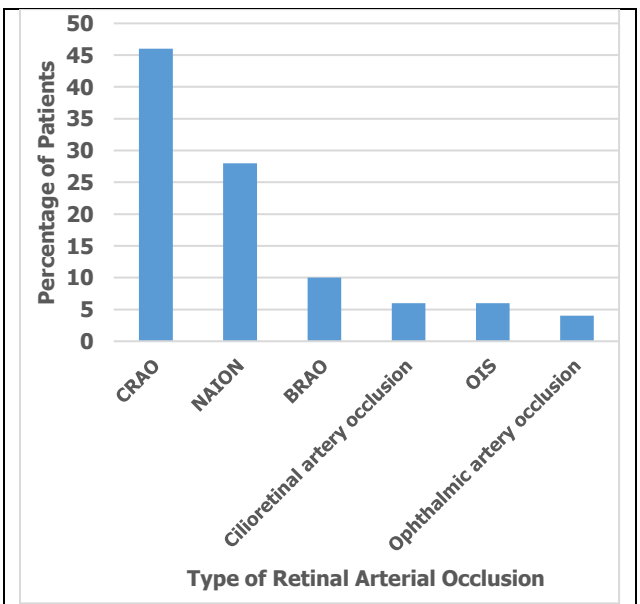

Figure 1. Distribution of Retinal Arterial Occlusion

In our study, maximum number of patients presented with CRAO (46 %), non-arteritic anterior ischaemic optic neuropathy (NAION) (28 %), BRAO (10 %), OIS (6 %), ophthalmic artery occlusion (4 %), cilioretinal artery occlusion (6 %).

In patients with CRAO, 10 out of 23 patients had visual acuity between PL+ to HM+. 13 out of 23 patients had visual acuity between CFCF to CF6 m. 6 patients with AION had visual acuity between CFCF to CF6 m. 8 out of 14 patients had visual acuity between 6/60 and 6/18. When the visual acuity of BRAO patients were checked,[4] patients had visual acuity between 6/60 and 6/18. 1 patient had a visual acuity of 6/12. Out of 3 patients with CilioRAO,[1] had a visual acuity of PL+, while other 2 had between counting of fingers close to face (CFCF) and CF 6 m. Out of 3 patients with OIS,[1] had a visual acuity of PL +, while other 2 had between CFCF and CF 6m. Both patients with Oph.AO occlusion had a visual acuity of PL-.

Risk Factor	Frequency	Percent
HT	37	74.0
DM	12	24.0
IHD	9	18.0
Abnormal FLP	38	76

Table 2. Distribution of Systemic Risk Factors in the Study Group

Hypertension was found in 37 (74 %) patients. Diabetes was present in 12 (24 %) patients. Ischaemic heart disease (IHD) was present in 9 (18 %) and abnormal fasting lipid profile was present in 38 (76 %).

Out of 50 patients in the study group, 37 patients (74 %) were found to be hypertensive. In the control group, 12 patients (24 %) were found to be hypertensive. P value was found to be < 0.05, i.e., it was statistically significant. Odds ratio was found to be 9.013 and confidential interval was 3.643 - 22.298.

12 patients (24 %) in the study group were found to be diabetic, while 5 subjects (10 %) in the control were found to have diabetes. P value is > 0.05, i.e., it was not statistically significant.

IHD	Case		Control		Total	
	N	%	N	%	N	%
Absent	41	82	47	94	88	88
Present	9	18	3	6	12	12
Total	50	100	50	100	100	100

Table 3. Distribution of IHD in Study Group and Control Group

Carotid Artery Occlusion	Case		Control		Total	
	N	%	N	%	N	%
Normal	21	42	37	74	**58**	**58**
< 50	13	26	13	26	**26**	**26**
50 - 70	3	6	0	0	**3**	**3**
➢ 70	13	26	0	0	**13**	**13**
Total	**50**	**100**	**50**	**100**	**100**	**100**

Table 4. Distribution of Carotid Artery Occlusion in the Study Group and Control Group

$\chi 2 = 20.414$, df = 1 , P = 0.000, Odds ratio = 3.930, Confidential interval =1.688-9.154.

In the study group, 18 % (9/50) were found to be having history of IHD. 3 subjects (47 %) in the control group had history of IHD. P value was found to be > 0.05, i.e., it is not statistically significant. In the study group, 74 % (37/50) were found to be having abnormal fasting lipid profile. 14 subjects (28 %) in the control group had abnormal FLP. P value was found to be < 0.05, i.e., it is statistically significant. Odds ratio was found to be 9.013 and confidential interval was 3.643 - 22.298.

According to the severity of carotid artery occlusion, patients were grouped into 3 groups - < 50 %, 50 - 70 %, > 70%. < 50 % occlusion was found in 26 % (13/50), 50 – 70 % was found in 6 % (3/50), more than 70 % occlusion was found in 26 % (13/50) in the study group. 26 % (13/50) of the control group had < 50 % occlusion. None in the control group had more than 50 % occlusion. P value was found to be < .05, i.e., it was statistically significant. Odds ratio was found to be 3.930 and confidential interval was 1.688 - 9.154. Logistic regression analysis was performed on the statistically significant variables namely hypertension, FLP & CD in the model.

The odds ratio of risk factors was statistically significant. They together account for 34.1 % of variation in the disease. When each variable is taken into account, abnormal FLP accounts for 17 % of variation of disease, HT accounts for 80 % of variation of disease and CD accounts for about 16 % of variation of disease.

DISCUSSION

This cross-sectional study included patients aged thirty and above, who had come to the department of ophthalmology with symptoms suggestive of arterial occlusions in the eye, over a period of one year from June 2008-2009. Both indoor and OPD patients were included in the study. Males and females coming from both urban and rural areas were included in the study. Since our study showed a strong association between arterial occlusion in the eye and carotid artery occlusion, all patients with retinal artery occlusion should be subjected to bilateral carotid doppler examination. Thorough examination of the other eye to rule out any thrombus or narrowing of the retinal artery was done.[22-27] As there was a strong association between abnormal fasting lipid profile and retinal arterial occlusion, the low-density lipoprotein (LDL) levels should be < 4.1 mmol/l in low-risk patients and 1.8 mmol/l in high-risk patients. Since hypertension is associated with arterial occlusion, blood pressure should be below 120/80. Maximum number of patients were between the age group of 51 - 60. Males were more affected than the females. So, our study shows an increase in incidence of arterial occlusions in the eye with age. When systemic factors were taken into consideration, hypertension and hypercholesterolemia showed a strong association with arterial occlusion in the eye.[28-31]

Patients with hypertension had nine times more risk to have arterial occlusions than the patients without it. When the general population was taken into consideration, the risk of developing arterial occlusions were 3.6 - 22.3 times more in patients with hypertension than in patients without hypertension. Patients with abnormal FLP had nine times more risk to have arterial occlusions than the patients without it. When the general population was taken into consideration, the risk of developing arterial occlusions were 3.6 - 22.3 times more in patients with abnormal FLP than in patients without it. There was no association between diabetes and arterial occlusions. Ischemic heart disease also showed no association with the disease.

Our study showed that the patients with carotid artery occlusion had four times more risk to have arterial occlusions in the eye than the patients without it. When the general population was taken into consideration, the risk of developing arterial occlusions were 1.7 - 9.15 times more in patients with carotid artery occlusion than in patients with normal carotids. Arterial occlusion was more found in patients with > 70 % occlusion of the carotid artery. So, our conclusion was that there was a strong association between carotid artery occlusive disease and retinal arterial occlusion. Retinal arterial occlusions are a cause for profound visual loss in the population. Carotid atherosclerosis is common in elderly. Dyslipidaemia, hypertension, and diabetes mellitus are factors which accelerate the development of carotid at hermatous plaques. Embolism from the carotid bifurcation is the most common cause of retinal artery occlusions. There was a strong association between retinal arterial occlusions and carotid artery occlusion. In retinal arterial occlusion, carotid arterial occlusion is usually assessed using radiological techniques. Retinal blood flow is regulated by both autonomic and local metabolic factors especially the demand for oxygen. So, any factor which disrupts the controlling factor can disrupt the retinal blood flow. Arterial occlusions in the eye are also related to various systemic diseases like hypertension, diabetes, ischemic heart disease, atherosclerosis etc. Types of carotid emboli are cholesterol, fibrinoplatelet, calcified and cardiac emboli. CRAO, ophthalmic artery occlusion and cilioretinal artery occlusion presents with sudden profound painless loss of vision. AION presents with painful loss of vision, while OIS presents with chronic progressive loss of vision. Patients presenting with retinal arterial occlusion should be investigated thoroughly for both systemic and local causes recently it has been shown that carotid ultrasonography may provide accurate information regarding both arterial lumen narrowing and plaque morphology. Ultrasonography is a simple, non-invasive technique which can be easily done on any kind of patients. All patients with arterial occlusion in the eye should be subjected to bilateral carotid ultrasound.[32-34] The pathophysiology of RAO is similar to cerebral stroke, with the majority of cases thought to be due to cardioembolic or artery-artery embolism, often the ipsilateral carotid artery. The systemic associations of RAOs in the Indian population were distinctly different from those reported in the Western population.

Hyperhomocysteinaemia was the commonest association found. Whereas associations reported in the Western population such as cardiac abnormalities, coagulation disorders, hemoglobinopathies and oral contraceptive use were uncommon. Retinal artery occlusion usually presents as painless loss of monocular vision. Ocular stroke is commonly caused by embolism of the retinal artery, although emboli may travel to distal branches of the retinal artery, causing loss of only a section of the visual field. Retinal artery occlusion represents an ophthalmologic emergency, and delay in treatment may result in permanent loss of vision.

Immediate intervention improves chances of visual recovery, but, even then, prognosis is poor, with only 21-35 % of eyes retaining useful vision. Although restoration of

vision is of immediate concern, retinal artery occlusion is a harbinger for other systemic diseases that must be evaluated immediately. A symptomatic retinal artery occlusion is an ophthalmic emergency that requires immediate evaluation and transfer to a stroke center. It is an obstruction of retinal blood flow that may be due to an embolus causing occlusion or thrombus formation, vasculitis causing retinal vasculature inflammation, traumatic vessel wall damage, or spasm. The lack of oxygen delivery to the retina during the blockage often results in severe vision loss in the area of ischemic retina. Patients often have concurrent silent ischemic stroke.

CONCLUSIONS

There was a strong association between retinal arterial occlusions and carotid artery occlusion. Hypertension had a strong association with retinal arterial occlusions. Abnormal fasting lipid profile had a strong association with retinal arterial occlusions. Diabetes and IHD were not found to be associated with retinal arterial occlusions. There was a strong association between retinal arterial occlusions and carotid artery occlusion. In retinal arterial occlusion, carotid arterial occlusion is usually assessed using radiological techniques. Retinal blood flow is regulated by both autonomic and local metabolic factors especially the demand for oxygen. So, any factor which disrupts the controlling factor can disrupt the retinal blood flow.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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