Correlation of ischemic ophthalmopathy with lacunar infarction

Min Wang¹, Yu-Fang Gao²,³, Wei Chen³, Rong Li⁴, Li-Hua Hou¹, Jian-Ying Du¹

¹Department of Ophthalmology, the First People’s Hospital of Xianyang, Xianyang 712000, Shaanxi Province, China
²Department of Laboratory Diagnosis, the Central Hospital of Xianyang, Xianyang 712000, Shaanxi Province, China
³Xi’an Jiaotong University, Xi’an 710000, Shaanxi Province, China
⁴Department of Ophthalmology, the First Affiliated Hospital, Xi’an Medical University, Xi’an 710000, Shaanxi Province, China

Cor-first authors: Min Wang and Yu-Fang Gao

Correspondence to: Wei Chen. Xi’an Jiaotong University, Xi’an 710000, Shaanxi Province, China. chenwei808@mail.xjtu.edu.cn

Received: 2019-03-21        Accepted: 2019-10-21

Abstract

- **AIM:** To investigate the correlation of ischemic ophthalmopathy (IO) with lacunar infarction (LI), an ischemic lesions in the cerebrovascular system.
- **METHODS:** Totally 204 cases of IO without any nervous system symptom and previously diagnosed LI served as the observational group. All 204 cases without IO, nervous system symptoms and previous LI served as the control group. Age and sex between the two groups matched well. LI was diagnosed by magnetic resonance imaging (MRI) and the results of the two groups were statistically analyzed and compared.
- **RESULTS:** IO included 174 eyes of 156 patients with non-arteritis anterior ischemic optic neuropathy (NAION), 42 eyes of 36 patients with central retinal artery occlusion (CRAO) or branch retinal artery occlusion (BRAO) and 12 eyes of 12 patients with ocular ischemia syndrome (OIS). The detection rate of LI (72.54%) in IO group was obviously higher than that (15.68%) in the control group (P<0.001). IO was positively correlated with LI (r=0.573, P<0.05). In addition, most infarction sites located in the basal ganglia (67.57%), which were not the vital areas of cerebrum and not easy to be found due to their small size. The majority of those first visited IO patients (72.54%) without nervous system symptom and previously diagnosed LI had already suffered from LI.

**CONCLUSION:** According to our studies, there is a positive correlation between IO and LI. IO can be used as an important predictor for the present of LI, especially obvious signs of the patient.

**KEYWORDS:** ischemic ophthalmopathy; lacunar infarction; non-arteritis anterior ischemic optic neuropathy; central retinal artery occlusion; branch retinal artery occlusion; ocular ischemia syndrome

DOI:10.18240/ijo.2020.06.16


INTRODUCTION

Ischemic ophthalmopathy (IO) is a group of diseases with pathological and physiological changes caused by ischemia of different tissues of the eye, which is one of the commonly encountered diseases in the Department of Ophthalmology¹⁻⁴, including non-arteritis anterior ischemic optic neuropathy (NAION), central retinal artery occlusion (CRAO), branch retinal artery occlusion (BRAO), ischemic optic neuropathy (ION) and ocular ischemia syndrome (OIS). Interestingly, most patients with IO were reported to have ischemic lesions in their cerebrovascular system (CVS)⁴⁻⁶. However, as visual functional impairment is the primary symptom of IO patients and there is light or no systemic symptoms, nervous system examination was easily neglected by ophthalmologists. Ischemic stroke is the general term of cerebral tissue necrosis caused by stenosis or occlusion of the cerebral artery (carotid artery and vertebral artery) and cerebral blood supply insufficient, which has the similar pathogenesis with IO⁷⁻⁹.

IO is mainly due to carotid artery stenosis, as well as attachment and defluxion of atherosclerosis plaque caused by artherosclerosis⁶⁻²⁰. Its occurrence is closely associated with age, sex, hypertension, diabetes, coronary heart disease and smoking, which also caused atherosclerosis⁶⁻²⁰. Internal carotid artery system originates from the common carotid artery, which mainly supplies ocular region and three-fifths of anterior part of cerebral hemisphere. Its main branches include ophthalmic artery and arteria chorioidea, which
supplies corpora striata, hippocamp, lateral geniculate body, cerebral peduncle, mammillary body and gray tubercle. While arteriosclerosis occurs in arteria carotis, especially the degree of narrowing exceeds 75%, ischemic lesions may occur in its supply areas. If complicated with microemboli and other predisposing factors, angiemphraxis diseases can occur at any time. On this occasion, ocular diseases mainly including CRAO, BRAO, and OIS turns out. As far as the brain is concerned, three types of lacunar infarction (LI) are the most common diseases, including ischemic attack, cerebral thrombosis and cerebral embolism.

In order to clarify the correlation between IO and ischemic lesions in CVS and investigate whether IO can predict LI, this present study was conducted.

**SUBJECTS AND METHODS**

**Ethical Approval** The study protocol was approved by the Institutional Ethics Committee at First People’s Hospital of Xianyang, and followed the principles of the Declaration of Helsinki. The informed consent was obtained from all patients. Totally 204 inpatients with IO, who had no nervous system symptom and history of LI, were recruited to participate in this study in Department of Ophthalmology, the First People’s Hospital of Xianyang, Shaanxi, China from October 2014 to October 2016. The IO group (132 male and 72 female) aged from 44 to 78y (mean age 60.7±3.4y). An age-and-sex matched control group consisted of 204 inpatients without IO from the Department of Ophthalmology, the First People’s Hospital of Xianyang, Xianyang, Shaanxi Province, China, same endemic area and they also had no nervous system symptom and history of LI. Neurologists performed the diagnosis for LI. Ischemic stroke diagnostic criteria in this article (including any one of the first items and 2-4): 1) there was no obvious symptoms and signs in the whole body; 2) nuclear magnetic resonance examination showed that brain edema, cerebral ischemia lesions in the low density region, and no hemorrhagic changes; 3) cerebral angiography found one or more of the main artery stenosis or occlusion of the change; 4) brain scan prompt and cerebral infarction except for brain tumors.

IO group included 144 eyes of 132 male patients and 84 eyes of 72 female patients. Age ranged from 44 to 78y (mean age 60.7±3.4y). In detail, IO group included 174 eyes of 156 patients with NAION, 42 eyes of 36 patients with CRAO or BRAO and 12 eyes of 12 patients with OIS. All participants were then divided into NAION group (156 cases), RAO group (36 cases) and OIS group (12 cases). Based on their general condition: hypertension, diabetes, hypertension and diabetes and no hypertension or diabetes, no significant differences between IO subgroups and control groups were found (P>0.05; Table 1).

General medical examination was performed in all participants. Visual acuity, slit lamp microscope, fundus examination, ophthalmomotonus, fluorescence fundus angiography (FFA), visual evoked potential (VEP) and electroretinogram (ERG) were performed in the Department of Ophthalmology. Otherwise, auxiliary examinations were performed, including blood, urine and excrement tests, X-ray examinations, electrocardiography and neck ultrasound doppler. Head magnetic resonance imaging (MRI) was performed after getting the agreement from all clients to affirm if LI had existed. According to the inspection, three neurologists performed the diagnosis by the way of double-blind method. Finally, LI were definitely diagnosed by history, clinical manifestation, auxiliary examination results, and reference in combination. Records of 204 IO patients and 204 control patients examined during a 24-month period were reviewed.

Experimental data were analyzed statistically by using the SPSS 13.0 software. The two groups of patients with body mass index, diabetes mellitus, hypertension, hyperlipidemia, high homocysteine, C reactive protein, smoking has confirmed incidence risk factors have influence on the two kinds of diseases on the logistic regression analysis, P<0.05 has statistical difference. The incidence of ischemic stroke in the two groups was adopted, $\chi^2$ test was performed for differences among groups. A $P$ value less than 0.05 was considered as statistically significant.
RESULTS

There was no statistical difference between the two groups of patients by logistic multi factor regression analysis ($P=0.09$), exclude the influence of systemic risk factors on the results. Among the finally diagnosed patients with LI, 148 case (72.54%) were in IO group and 32 cases (15.68%) were in control group. The difference of LI detection rate between the two groups was statistically significant ($\chi^2=21.501, P=0.000$; Table 2). MRI detection rates of LI between the two groups had statistical difference ($\chi^2=21.501, P<0.001$). The comparison of sex in LI patients of IO group was not statistically different ($\chi^2=0.241, P=0.612$). IO was positively correlated with LI ($r=0.573, P=0.000$).

Among 148 cases of patients with LI in IO group, 84 cases were male patients (63.64% in all male patients) and 64 cases were female patients (88.89% in all female patients). The difference of LI detection rate between male and female gender was not statistically significant ($\chi^2=0.241, P=0.612$). IO was positively correlated with LI ($r=0.573, P=0.000$).

Among the finally diagnosed patients with LI and positive MRI, 112 case (71.79%) were in NAION group and 24 cases (15.38%) were in control group. The difference of LI detection rate between the two groups was statistically significant ($\chi^2=20.401, P=0.000$); the difference of intra-ocular tension between two groups was not statistically significant ($t=0.912, P=0.941$; Table 3, Figure 1). NAION was positively correlated with LI ($r=0.559, P=0.000$).

Among the finally diagnosed patients with LI and positive MRI, 26 case (72.22%) were in RAO group and 6 cases (16.67%) were in control group. The difference of LI detection rate between the two groups was statistically significant ($\chi^2=20.611, P=0.000$); the difference of intra-ocular tension between two groups was not statistically significant ($t=0.912, P=0.941$; Table 4, Figure 2). RAO was positively correlated with LI ($r=0.559, P=0.000$).

Among the finally diagnosed patients with LI and positive MRI, 10 case (83.33%) were in OIS group and 2 cases

---

**Table 2 Clinical manifestations of LI in IO group and control group**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Positive MRI (%)</th>
<th>Negative MRI (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO group</td>
<td>148 (72.54)</td>
<td>56 (27.45)</td>
<td>204</td>
</tr>
<tr>
<td>Control group</td>
<td>32 (15.68)</td>
<td>172 (84.31)</td>
<td>204</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>228</td>
<td>408</td>
</tr>
</tbody>
</table>

IO: Ischemic ophthalmopathy; MRI: Magnetic resonance imaging.

**Table 3 Clinical manifestations of LI in NAION group and control group**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Positive MRI (%)</th>
<th>Negative MRI (%)</th>
<th>Intra-ocular tension (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAION group</td>
<td>112 (71.79)</td>
<td>44 (28.21)</td>
<td>15±2.15</td>
</tr>
<tr>
<td>Control group</td>
<td>24 (15.38)</td>
<td>132 (84.62)</td>
<td>14±2.23</td>
</tr>
</tbody>
</table>

NAION: Non-arteritis anterior ischemic optic neuropathy; MRI: Magnetic resonance imaging.

---

**Figure 1 Images of a patient with anterior ischemic optic neuropathy in his left eye**

A: Fundus photograph showed the cord-like bleeding and edema underneath optic disc, which boundary was fuzzy; B: FFA image showed that fluorescence was shielded by the bleeding underneath optic disc, fluorescence leakage, and fuzzy papillary boundary; C: MRI showed multiple lacunar infarction (T2 high signal lesions) existed in the side of bilateral ventricle body and the basal ganglia.

**Figure 2 Images of a patient with branch retinal artery occlusion in his right eye**

A: Fundus photograph showed greyish edema in the inferotemporal retina due to branch arterial occlusion; B: FFA image showed filling defect in the field of inferotemporal branch arterial occlusion; C: MRI showed multiple lacunar infarction (T2 high signal lesions) existed in the right basal ganglia.
Based on this, after IO is finally diagnosed, systemic and brain examination, especially MRI, is necessary to affirm if LI occurs. Meanwhile, getting a physician consultation and making a final diagnosis is critical, in order to treat systemic diseases in time while treating the disease of eyes. In addition, this study also showed that 65.57% of infarction areas was basal ganglia but not the key regions of the brain. The lesion area was small and not easy to be found, so early etiological examination should be performed for this kind of patients. Meanwhile, according to the examination results, prophylactic treatment should be performed to reduce the risk of cerebrovascular accidents. There are some limitations in this study, which cannot completely indicate that ischemic stroke and IO have exactly the same risk factors. In the future, we will pay attention to this aspect.

According to our studies, LI incidence in IO patients was significantly higher than in non-IO ones, and there was a positive correlation between IO and LI. IO can be used as a predictor of LI, especially obvious signs of the patient. We expect the ophthalmologists to timely diagnose patients with ischemic lesions in CVS and give them positive and reasonable treatment in clinical practice.

ACKNOWLEDGEMENTS

Foundations: Supported by National Natural Science Foundation of China (No.81500726); Health Research Program of Shaanxi, China (No.2014E12); Shaanxi Health Research Foundation (No.2016E007).

Conflicts of Interest: Wang M, None; Gao YF, None; Chen W, None; Li R, None; Hou LH, None; Du JY, None.

REFERENCES

Ischemic ophthalmopathy with lacunar infarction


