Association between Retinal Microvascular Changes and Severity of Coronary Heart Disease in Hypertensive Patients

ABU BAQAR MD JAMIL, KHALED MOHAMMAD IQBAL, MOHAMMAD ASHRAF HOSSAIN, KHANDAKER HARUN-OR-RASHID, MD. TUFAZZAL HOSSEN, ALOK CHANDRA SARKER, MD SHAHADAT HOSSAIN, MRINAL KANTI DAS, SYED ALI AHSAN

Department of Cardiology, Sheikh Hasina Medical College, Jamalpur, Bangladesh, Department of Cardiology, MAG Osmani Medical College, Sylhet, Bangladesh, Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Address of Correspondence: Abu Baqar Md Jamil, Assistant Professor, Department of Cardiology, Shaheed Ziaur Rahman Medical College, Bogura, Bangladesh, Email: drjamilbogra@gmail.com

Abstract:

Background: The prevalence of coronary artery disease is increasing day by day. In many cases it is undiagnosed. Hypertension is one of the risk factors of coronary artery disease. Hypertension also causes some changes in retina which is easy to diagnose in clinical practice. So the aim of this study is to predict coronary artery disease by seeing hypertensive retinal changes.

Methods: A total of 100 patients with hypertension presenting to the emergency department with ischemic chest pain who underwent coronary angiography were studied. Presence or absence of coronary artery disease was determined. Optic fundi were assessed for hypertensive retinopathy which were photographed.

Results: Mean ± SD age of the study population was 56.23±10.76 years. There were 75 men (75%) and 25 women (25%). Prevalence of coronary artery disease and hypertensive retinopathy were 84% and 44% respectively. There was association between coronary artery disease and retinopathy (P< 0.017). Age (P= 0.019), smoking (P=0.011) and dyslipidaemia (P=0.039) were identified as risk factors for coronary artery disease.

Conclusion: Important observations from this study are that hypertensive retinopathy has an association with coronary artery disease. Retinal change can be used in predicting coronary artery disease in patients with hypertension which can be used as screening tool for diagnosing coronary artery disease in resource poor settings.

Received: 15 April, 2022

Accepted: 15 June, 2022

Introduction:

Coronary heart disease (CHD) remains the leading cause of death worldwide and leads to substantial economic burden.27 Traditional risk factors such as smoking, hypertension hyperlipidemia and diabetes are thought to explain most CHD,8 although, 15-20% of those with CHD have no identified traditional risk factors and miss the opportunity for primary prevention.5 The retinal vessels can be observed directly and non-invasively, and are therefore, clinically useful for assessing the systemic microvasculature.35

Retinal micro vascular abnormalities, such as generalized and focal arteriolar narrowing, arteriovenous nipping and retinopathy, reflect cumulative vascular damage from hypertension.15 There are data supporting an association between retinal micro vascular abnormalities and stroke, but there is no convincing evidence of an independent or direct association with hypertensive retinal change and coronary artery disease severity.2 When reliably quantified, retinal micro vascular abnormalities may be useful as risk indicators for cardiovascular diseases.

However, to the best of our knowledge, the relationship between changes in the retinal micro vascular structure and severity and extent of coronary heart disease (CHD) estimated by coronary angiography, has yet to be thoroughly investigated. The present study was undertaken to assess whether retinal micro vascular signs are associated with CHD severity and extent, among patients presenting with suspected CHD. The data from this study will add to new knowledge by determining the potential
value of retinal micro vascular changes as prognostic markers of CHD risk, and whether there is a role for non-invasive retinal imaging of CHD suspects that could add to or precede coronary angiography.

Materials and methods:
Place of study: University Cardiac Center (UCC) and department of Ophthalmology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka.

Study period: July 2015 to June 2016

Study design: Cross-sectional observational study.

Study population: Hypertensive patients admitted with typical ischemic chest pain in University Cardiac Center of BSMMU during the study period. Both male and female patients were included after taking informed written consent.

Selection criteria:

Inclusion criteria
1. Hypertension (as per JNC VII guideline)
2. Patients with typical ischemic chest pain.
3. Who underwent coronary angiography according to ACC/AHA guideline.
4. Who agreed for ophthalmoscopic examination.

Exclusion criteria
1. Diabetes mellitus/ impaired glucose tolerance, as defined by the American Diabetes Association
2. Presence of overt nephropathy (creatinine ≥1.5 mg/dL) or CKD
3. Known patients with CAD and were on treatment.
4. Who were managed medically without angiogram.
5. Presence of cataract

Variables
• Age • sex • BMI • smoking • Blood pressure (mmHg) level and duration • LVH on Echocardiography • Coronary artery lesion • Retinopathy • Family history of CHD

Ethical clearance was obtained from the Institutional Review Board (IRB) of BSMMU. According to Helsinki declaration for Medical Research involving Human Subjects 1964, all the patients be informed about the study design, the underlying hypothesis and the right for the participants to withdraw themselves from the projects at any time, for any reason, what so ever which will not hamper the standard duty of care anyway. Written informed consent will be obtained from each subject who will voluntarily provide consent to participate in the study. The ethical issues will be addressed accordingly.

Results:
A total 100 hypertensive patients with typical ischaemic chest pain admitted into University Cardiac Centre, BSMMU, who underwent coronary angiography were included into the study. Fundal photography were taken in retinal clinic of BSMMU. Based on coronary angiography 84 patients had coronary artery disease, 16 patients had normal coronary arteries or insignificant lesion. Based on ophthalmoscopic findings 44 patients had hypertensive retinal changes and 66 patients had normal findings. The details of the study results are described below

Table-I

Demographic characteristics of the patients. (n=100)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>CAD Significant (n=84)</th>
<th>No or Insignificant (n=16)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age* (yrs)</td>
<td>58.5±9.0</td>
<td>49.7±10.9</td>
<td>0.019*</td>
</tr>
<tr>
<td>Sex**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>63 (75)</td>
<td>12 (75)</td>
<td>1.000ns</td>
</tr>
<tr>
<td>Female</td>
<td>21 (25)</td>
<td>4 (25)</td>
<td></td>
</tr>
</tbody>
</table>

*Data were analyzed using unpaired t-Test and were presented as mean±SD
n = Number of study population
s = significant
ns = non significant
**X² Test was done to analyze the data; Figure in the parentheses indicate corresponding percentage.

Patients with significant CAD were on an average older than those who did not suffer from significant CAD. There was no significant difference between two groups in terms of sex.

Table-II

Distribution of the study patients according to stage of hypertension (n=100)

<table>
<thead>
<tr>
<th>Stage of hypertension</th>
<th>CAD Significant (n=84)</th>
<th>No or Insignificant (n=16)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>JNC VII stage I</td>
<td>60 (71)</td>
<td>12 (75)</td>
<td>0.693ns</td>
</tr>
<tr>
<td>JNC VII stage II</td>
<td>24 (29)</td>
<td>4 (25)</td>
<td>0.732ns</td>
</tr>
</tbody>
</table>

X² Test was done to analyze the data; Figure in the parentheses indicate corresponding percentage.
n = Number of study population
ns = non significant

Table II compared stage of hypertension between two groups. There was no significant difference between groups.
Discussion:
Analysis of baseline differences between patients with and without coronary heart disease was done using t test which showed significant difference in age, smoking, dyslipidaemia and retinopathy between groups. GhanshyamPalamaner et al. 2009 showed in their study no significance difference in smoking and dyslipidaemia between two groups but showed significant difference in sex and retinopathy. Among patients with coronary heart disease (n=84), there was coexistent hypertensive retinopathy in 42 patients (50%). This result is similar in previous study in which GhanshyamPalamaner et al. 2009 showed 55.2% patients of coronary heart disease had hypertensive retinopathy. In our study among patients without coronary heart disease (n=16), retinopathy was present in 2 patients (12.5%) which was 14% in previous study.

Data of this study support the hypothesis that hypertensive retinopathy is positively associated with significant

Table-III

<table>
<thead>
<tr>
<th>Stages of hypertensive retinopathy</th>
<th>Gensini score mean±SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal findings (n=42)</td>
<td>8.16±4.17</td>
<td></td>
</tr>
<tr>
<td>Stage 1 hypertensive retinopathy (n=22)</td>
<td>16.34±6.31</td>
<td>&lt;0.001s</td>
</tr>
<tr>
<td>Stage 2 hypertensive retinopathy (n=16)</td>
<td>28.43±9.23</td>
<td></td>
</tr>
<tr>
<td>Stage 3 hypertensive retinopathy (n=3)</td>
<td>37.51±11.12</td>
<td></td>
</tr>
<tr>
<td>Stage 4 hypertensive retinopathy (n=1)</td>
<td>48.23±15.65</td>
<td></td>
</tr>
</tbody>
</table>

n = Number of study population
s = significant
P value reached from Chi square test
Data were analyzed using one way ANOVA statistics and were presented as mean±SD

Table III showed more the grade of hypertensive retinopathy, the more is the Gensini score.

Table-IV

<table>
<thead>
<tr>
<th>Gensini score in patients with or without hypertensive retinopathy (n=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertensive retinopathy present (n=44)</td>
</tr>
<tr>
<td>Hypertensive retinopathy absent (n=56)</td>
</tr>
</tbody>
</table>

n = Number of study population
s = significant
P value reached from t test

There is significant difference in Gensini score in patients with retinopathy than without retinopathy. r=+.686, p<0.001

Fig.-1: Scatter diagram showing correlation between Gensini score and stages of hypertensive retinopathy

Spearman’s correlation test showed significant positive correlation between hypertensive retinopathy and coronary artery disease.

Table-V

<table>
<thead>
<tr>
<th>Regression analysis showing predictors of CAD (N=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Smoking</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
</tr>
<tr>
<td>Retinopathy</td>
</tr>
</tbody>
</table>

n= Number of the study population
ns=Not significant
CI= confidence interval

Multivariate analysis was performed using stepwise logistic regression and retinopathy found as independent predictors CAD.

Discussion:
Analysis of baseline differences between patients with and without coronary heart disease was done using t test which showed significant difference in age, smoking, dyslipidaemia and retinopathy between groups. GhanshyamPalamaner et al. 2009 showed in their study no significance difference in smoking and dyslipidaemia between two groups but showed significant difference in sex and retinopathy. Among patients with coronary heart disease (n=84), there was coexistent hypertensive retinopathy in 42 patients (50%). This result is similar in previous study in which GhanshyamPalamaner et al. 2009 showed 55.2% patients of coronary heart disease had hypertensive retinopathy. In our study among patients without coronary heart disease (n=16), retinopathy was present in 2 patients (12.5%) which was 14% in previous study.

Data of this study support the hypothesis that hypertensive retinopathy is positively associated with significant
coronary heart disease. Previous reports have noted an association between hypertensive retinopathy and coronary heart disease.³

This study results found that hypertensive retinopathy is not only a simple marker of atherosclerosis, but also correlates with the coronary angiographic Gensini score, which was calculated to yield a measure of the extent and severity of coronary atherosclerosis.

Thus the study opinions, patients with hypertensive retinopathy had higher gensini scores because they had both more significant coronary lesion and a higher incidence of double and triple vessel disease.

Previous studies have suggested that the presence of hypertensive retinopathy is a marker of cardiovascular morbidity.⁷ This study results support this finding. And hypertensive retinopathy may serve as a window showing the atherosclerotic burden of the coronary arteries which can be used as a non invasive marker of CHD.

**Conclusion:**
Coronary heart disease showed an association with retinopathy. Hypertensive retinal changes can be used in predicting CHD. Fundoscopy is a non invasive test that can be performed in short time in physician’s chamber. It costs nothing and hence may be used as an early screening tool in a resource poor setting for predicting CHD in hypertensive patients.

**Recommendation**
1. Hypertensive retinopathy may be used as a screening tool to predict coronary heart disease
2. Further studies are needed in large scale to evaluate the role of Hypertensive retinopathy as a screening tool.

**Limitation of the Study:**
Grade I retinopathy can occur as a consequence of ageing and hence cannot be clearly attributed to hypertension.

Sample size was small.

**Acknowledgement:**
This study was a postgraduate thesis. The authors would like to thank all of the patients who enrolled in this study and staff of the Department of Cardiology, University Cardiac Center, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Financial support was obtained from the Research Council of the Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

**References:**


