RESEARCH LETTERS

Intraocular Pressure and Arterial Blood Pressure: The Central India Eye and Medical Study

Because intraocular pressure and arterial blood pressure counteract each other with respect to the so-called ocular perfusion pressure, it was the purpose of this study to assess a potential relationship between intraocular pressure and the arterial blood pressure.

Methods. The Central India Eye and Medical Study is a population-based study in central India carried out in villages about 40 km from Nagpur. The medical ethics committee of Heidelberg University approved the study and all of the participants gave informed consent. We describe an interim analysis of the examination of individuals in 6 villages for which the recruitment was completed. Of 4291 individuals aged 30 years or older, 3393 participated (response rate, 79.1%). Intraocular pressure was measured by Goldmann applanation tonometry, and central corneal thickness was measured by ultrasonic pachymetry. The intraobserver agreement expressed as a coefficient of variation was 7.2% for corneal thickness measurements, 3.1% for systolic blood pressure measurements, and 4.5% for diastolic blood pressure measurements. Statistical analysis was performed using SPSS for Windows version 16.0 statistical software (SPSS, Inc, Chicago, Illinois).

Results. The study included 3373 subjects (99.4%) for whom intraocular pressure and blood pressure measurements were available. The mean (SD) age was 47.9 (13.8) years (range, 30-100 years) and the mean (SD) refractive error was –0.18 (1.74) diopters (D) (range, –20.0 to +14.0 D). Known arterial hypertension was present in 191 subjects (5.7%), of whom 60 (31.1%) received antihypertensive medication, 96 (49.7%) were not sure about their treatment, and 35 (18.1%) did not receive antihypertensive medication. Of the entire study population, 566 subjects (16.8%) indicated that they were current or former smokers.

In a univariate analysis, intraocular pressure was significantly correlated with higher systolic blood pressure (\(P=.001\); correlation coefficient, \(r=0.17\)), higher diastolic blood pressure (\(P<.001\); correlation coefficient, \(r=0.20\)), greater central corneal thickness (\(P<.001\); \(r=0.23\)), higher body mass index (calculated as weight in kilograms divided by height in meters squared) (\(P<.001\); \(r=0.11\)), and myopic refractive error (\(P=.03\); \(r=0.04\)). It was not significantly associated with age (\(P=.11\); \(r=0.03\)) or sex (\(P=.63\)). In a multivariate regression analysis, intraocular pressure was still significantly associated with higher systolic blood pressure (\(P=.001\)), higher diastolic blood pressure (\(P<.001\)), greater central corneal thickness (\(P<.001\)), and higher body mass index (\(P=.04\)). Similar results were obtained in a second step of the multivariate analysis in which all of the subjects with an intraocular pressure greater than 21 mm Hg were excluded, with significant associations between intraocular pressure and higher systolic blood pressure (\(P<.001\)), higher diastolic blood pressure (\(P=.003\)), greater central corneal thickness (\(P<.001\)), higher body mass index (\(P=.005\)), and younger age (\(P=.02\)).

Comment. Despite considerable scattering of the data and confirming previous reports from the Blue Mountains Eye Study, \(^2\) Beaver Dam Eye Study, \(^3\) Beijing Eye Study, \(^4\) and Los Angeles Latino Eye Study, \(^5\) the results suggest that in the central Indian population, intraocular pressure is significantly associated with higher systolic and diastolic blood pressure in addition to associations with younger age, greater central corneal thickness, and higher body mass index. Our study extends the findings from the previous investigations to the population of rural central India, which owing to its rather rural character and relatively low density of medical infrastructure may be different from the highly developed regions of the Blue Mountains Eye Study and the Beaver Dam Eye Study with mostly white populations, the Los Angeles region with a mostly Hispanic population, and the Greater Beijing area with a mostly Han Chinese population. \(^6\) Since the cerebrospinal fluid pressure as the translamina counterpressure against the intraocular pressure may also depend on arterial blood pressure and because a recent clinical study suggested an association between glaucoma and cerebrospinal fluid pressure, \(^6\) the physiological and pathophysiological roles of the association between intraocular pressure and arterial blood pressure with respect to glaucoma may become the focus of further studies.

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Lipoprotein-associated phospholipase A₂ (Lp-PLA₂) has been suggested to be a predictor of coronary heart disease and stroke. It is a calcium-independent serine lipase produced predominantly by macrophages, and it co-travels with circulating low-density lipoprotein. Its biological role is controversial. Initial reports suggested anti-inflammatory properties because of its ability to hydrolyze platelet-activating factor and to remove polar phospholipids in modified low-density lipoprotein. Conversely, recent studies indicated a proinflammatory role of Lp-PLA₂ mediated by its reaction products (lysocephosphatidylcholine and oxidized free fatty acids). Lipoprotein-associated phospholipase A₂ is an inflammatory marker and can directly promote atherogenesis. The potential clinical benefit associated with Lp-PLA₂ inhibition or its use as an inflammatory marker provides a rationale for this study. Because inflammation, atherosclerosis, and other cardiovascular risk factors are associated with age-related macular degeneration (AMD), the aim of this study was to examine associations between baseline plasma levels of Lp-PLA₂ and risk of AMD.

Methods. A case-cohort design was used within the Rotterdam Study, a population-based prospective cohort study in the elderly. The methods of the Rotterdam Study have been described elsewhere.

From the 6418 participants at risk for AMD at baseline, a random subcohort of 1648 individuals was drawn. Baseline examinations were performed between March 1990 and September 1993 and were followed by 3 follow-up examinations every 2 to 3 years. Plasma aliquots prepared from nonfasting blood samples were collected at baseline and stored at −80°C. The Lp-PLA₂ activity was measured with a high-throughput radiometric activity assay as described previously and was expressed as nanomoles of platelet-activating factor hydrolyzed per minute per milliliter of plasma sample. We tested for differences in baseline characteristics (age, sex, smoking, C-reactive protein level, body mass index [calculated as weight in kilograms divided by height in meters squared], systolic and diastolic blood pressures, and total and high-density lipoprotein cholesterol levels) between the subcohort and the remainder of the Rotterdam Study participants using analysis of covariance for continuous variables and logistic regression for discrete variables adjusting for age and sex. The Mann-Whitney U test was used for the C-reactive protein level because its distribution was skewed. Likewise, we tested for differences between AMD cases and noncases. We used Cox proportional hazards models to compute hazard ratios adjusted for age, sex, and high-density lipoprotein level (SPSS version 15.0 statistical software; SPSS, Inc, Chicago, Illinois). We did not stratify for type of AMD because of the small number of participants with late AMD. The Erasmus Medical Center Ethics Committee approved the study, which complies with the Declaration of Helsinki. All of the participants gave written informed consent.

Results. Characteristics of the subcohort were similar to those of the remaining population of the Rotterdam Study with a few minor exceptions. Participants of the subcohort as compared with the remaining population were younger (mean age, 68.5 vs 69.2 years, respectively) and had lower systolic blood pressure (mean, 138.0 vs 139.8 mm Hg, respectively). Participants with AMD as compared with those without AMD were older (mean age, 68.7 vs 66.5 years, respectively), were more often male (46.3% vs 38.5%, respectively), and had higher high-density lipoprotein levels (mean, 55 vs 52 mg/dL, respectively; [to convert to millimoles per liter, multiply by 0.0259]). No other differences existed between those with AMD and those without AMD. During follow-up (mean, 6.9 years), 164 cases with incident AMD (139 with early AMD, 25 with late AMD) were identified. The fully adjusted hazard ratio per unit increase of Lp-PLA₂ activity was 1.00 (95% confidence interval, 0.99-1.02). Compared with the lowest tertile of Lp-PLA₂ activity, the hazard ratio for the second tertile was 1.19 (95% confidence interval, 0.81-1.73) and the hazard ratio for the third tertile was 1.04 (95% confidence interval, 0.69-1.57) (P for trend = .85) (Table).

<table>
<thead>
<tr>
<th>Cases of age-related macular degeneration, No. (%)</th>
<th>Lp-PLA₂ Activity as Continuous Variable</th>
<th>Lp-PLA₂ Activity Tertile</th>
<th>P Value for Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (95% CI)</td>
<td>Low (12.4)</td>
<td>Middle (14.6)</td>
<td>High (11.7)</td>
</tr>
<tr>
<td>Unadjusted</td>
<td>164 (12.9)</td>
<td>53 (12.4)</td>
<td>62 (14.6)</td>
</tr>
<tr>
<td>Adjusted for age and sex</td>
<td>1.00 (0.99-1.01)</td>
<td>1.00 (0.98-1.01)</td>
<td>1.00 (0.99-1.02)</td>
</tr>
<tr>
<td>Adjusted for age, sex, and HDL cholesterol level</td>
<td>1.00 (0.99-1.01)</td>
<td>1.00 (0.98-1.01)</td>
<td>1.00 (0.99-1.02)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HDL, high-density lipoprotein; HR, hazard ratio; Lp-PLA₂, lipoprotein-associated phospholipase A₂; NA, not applicable.