Brief report

Carotid Intima-Media Thickness in Diabetics and Hypertensive Patients

Manuel A. Gómez-Marcos, a,* José I. Recio-Rodríguez, a Emiliano Rodríguez-Sánchez, a
María C. Patino-Alonso, b Rosa Magallón-Botaya, c Vicente Martínez-Vizcaino, d
Leticia Gómez Sánchez, a and Luis García-Ortiz a

a Unidad de Investigación La Alamedilla, REDIAPP, Salamanca, Spain
b Departamento de Estadística, Universidad de Salamanca, Salamanca, Spain
c Centro de Salud Arrabal, REDIAPP, Zaragoza, Spain
d Centro de Estudios Socio-Sanitarios, Universidad de Castilla-La Mancha, Cuenca, Spain

INTRODUCTION

Carotid intima-media thickness (IMT) is related to cardiovascular risk factors and diseases, and its measurement by means of ultrasound makes it possible to detect thickening in the initial phases of atherosclerosis. 1,2 For every 0.1-mm increase in carotid IMT, the relative risk of ischemic heart disease increases by 15% and that of cerebrovascular disease by 18%. 3 In type 2 diabetes mellitus (DM2) patients, the carotid IMT is 0.13 mm greater than in the controls. This implies an increase in age of 10 years, a circumstance that is related to a 40% higher cardiovascular risk. 4 Hypertensive patients, even those in a state of prehypertension, have a greater carotid IMT than controls. 5 In Spain, carotid IMT values in patients with no cardiovascular risk factors are available, 6,7 but we have no data on the carotid IMT in DM2 and hypertensive patients versus controls and to analyze the increase in carotid IMT with age.

METHODS

We performed a descriptive, cross-sectional study from December 2006 to June 2009. We included consecutively all patients between the ages of 25 and 80 years without previous cardiovascular disease referred to the research unit. The sample was comprised of 562 subjects (121 diabetics, 352 hypertensive patients, 89 controls). The mean intima-media thickness was 0.781 mm in diabetics, 0.738 mm in hypertensive patients and 0.686 mm in controls. The difference in intima-media thickness between diabetics and controls and between hypertensive patients and controls, adjusted for age, was 0.040 and 0.026 mm, respectively. We observed an increase in intima-media thickness of 0.005 mm in diabetics and of 0.005 mm in controls with every additional year of age. We found carotid damage in 23% of the diabetics, 12% of the hypertensive patients and 3.4% of the controls. In conclusion, the intima-media thickness is greater in diabetics, but the annual increase in the thickness is greater in hypertensive patients.
The clinical, anthropometric and analytical data collected are shown in Table 1. The measurement procedure has been described previously.8

Two trained researchers measured the carotid IMT, and reliability was evaluated prior to beginning the study by means of the intraclass correlation coefficient, with values of 0.974 for intraobserver agreement with regard to repeated measurements in 20 subjects, and 0.897 for interobserver agreement. To optimize reproducibility, we employed a SonoSite Micromaxx ultrasound system (SonoSite Inc, Bothell, Washington, United States) using a 5-10 MHz multifrequency high-resolution linear transducer with the Sonocal software package to perform automated measurements of the mean and maximum carotid IMT, with a discrimination limit expressed in microns. The measurements were carried out in common carotid arteries, and the average mean and maximum values were recorded. We determined the influence of age on carotid IMT using multivariate linear regression analysis, establishing four models: model 1, adding the traditional risk factors (smoking habit, systolic blood pressure, diastolic blood pressure, pulse pressure, heart rate, body mass index, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides and baseline blood glucose); model 2, adding the traditional risk factors plus systolic blood pressure, diastolic blood pressure, pulse pressure, heart rate, and baseline blood glucose; model 3, adding the traditional risk factors plus systolic blood pressure, diastolic blood pressure, pulse pressure, heart rate, and baseline blood glucose; model 4, adding the emerging risk factors (waist circumference, C-reactive protein, plasma fibrinogen and insulin resistance) to the previous model. We used the SPSS/PC+ 17.0 statistical software package.

RESULTS

The traditional and emerging risk factors and the ultrasound variables are shown according to groups in Table 1. The difference in carotid IMT between diabetics and controls was 0.095 mm
Three subjects had carotid injury. In the logistic regression analysis, using the presence of carotid injury as a dependent variable and age as a reference variable, in diabetics, for each one-year increase in age, the odds ratio (OR) for presence of carotid injury was 1.05 (95% CI, 1.07-1.16; ß = 0.112; P < .001); in model 3, OR = 1.22 (95% CI, 1.06-1.61; ß = 0.276; P = .002); and in model 4, OR = 1.39 (95% CI, 1.06-1.61; ß = 0.276; P = .007); the controls were not included because only three subjects had carotid injury.

According to the linear regression line (Fig. 1), the carotid IMT increased by 0.005 mm for every year of age in diabetics and in controls, and by 0.006 mm per year in hypertensive patients, but diabetic and hypertensive patients had higher carotid IMT values at the start of the study.

In the logistic regression analysis, using the presence of carotid injury as a dependent variable and age as a reference variable, in diabetics, for every one-year increase in age we can expect an increment in carotid IMT of 0.005 mm in the first three models and of 0.004 mm upon adding the emerging risk factors in model 4. In hypertensive patients, the increment in carotid IMT for every one-year increase in age remains constant in the four models (0.006 mm). In the controls, the beta coefficient ranged from 0.004 mm to 0.006 mm, and the greatest increment in carotid IMT was produced when adjustment was made for sex (0.006 mm); upon adjustment for the traditional and emerging risk factors, the increase in carotid IMT was 0.005 mm and 0.004 mm, respectively (Table 2).

Multiple linear regression analysis showed that, in diabetics, for every one-year increase in age we can expect an increment in carotid IMT of 0.005 mm in the first three models and of 0.004 mm upon adding the emerging risk factors in model 4. In hypertensive patients, the increment in carotid IMT for every one-year increase in age remains constant in the four models (0.006 mm). In the controls, the beta coefficient ranged from 0.004 mm to 0.006 mm, and the greatest increment in carotid IMT was produced when adjustment was made for sex (0.006 mm); upon adjustment for the traditional and emerging risk factors (waist circumference, C-reactive protein, plasma fibrinogen and HOMA [Homeostasis Model Assessment] index).

Table 2

<table>
<thead>
<tr>
<th></th>
<th>β (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diabetics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1: age</td>
<td>0.005 (0.003-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 2: age and sex</td>
<td>0.005 (0.004-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 3: age, sex and traditional risk factors</td>
<td>0.005 (0.002-0.008)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 4: age, sex, traditional risk factors and emerging risk factors</td>
<td>0.004 (0.001-0.008)</td>
<td>.014</td>
</tr>
<tr>
<td><strong>Hypertensive patients</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1: age</td>
<td>0.006 (0.005-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 2: age and sex</td>
<td>0.006 (0.005-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 3: age, sex and traditional risk factors</td>
<td>0.006 (0.005-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 4: age, sex, traditional risk factors and emerging risk factors</td>
<td>0.006 (0.005-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Controls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1: age</td>
<td>0.005 (0.004-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 2: age and sex</td>
<td>0.006 (0.004-0.007)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 3: age, sex and traditional risk factors</td>
<td>0.005 (0.002-0.008)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 4: age, sex, traditional risk factors and emerging risk factors</td>
<td>0.004 (0.003-0.008)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

CI: confidence interval.

Dependent variable: average mean carotid intima-media thickness. Reference variable: age. Model 1: adjusted for age. Model 2: adjusted for age and sex. Model 3: adjusted for age, sex and traditional risk factors (smoking habit, office systolic blood pressure, office diastolic blood pressure, pulse pressure, heart rate, body mass index, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides and altered baseline blood glucose). Model 4: adjusted for age, sex, traditional risk factors and emerging risk factors (waist circumference, C-reactive protein, plasma fibrinogen and HOMA [Homeostasis Model Assessment] index).

Figure 1. Simple linear regression lines, regression equations and r and P values showing the correlations between mean intima-media thickness and age in diabetics, hypertensive patients and controls.
DISCUSSION

Our study shows that the carotid IMT and the incidence of carotid injury are greater in diabetics; hypertensive patients have intermediate values and the controls, lower; the differences in carotid IMT are maintained after adjustment for age.

Patients with DM2 have an average mean age-adjusted carotid IMT 0.04 mm greater than the controls, a value lower than that reported by Brohall et al, who measured the carotid IMT in predefined segments (0.09 mm). The difference between hypertensive patients and controls in terms of carotid IMT is 0.026 mm, with an annual increment of 0.006 mm. These findings are similar to those of Puerto et al with respect to the difference in carotid IMT, but lower than the annual mean increment of 0.11 mm over 5 years of follow-up.

The data in Spain in individuals without risk factors reflect an increase in the annual mean carotid IMT of 0.005 mm and 0.006 mm per year, similar to the controls in this report. In the United States, based on annual carotid IMT measurements, a yearly progression of 0.010 mm has been estimated and, in Japan, this value is 0.006 mm. The differences can be explained, in addition to the origin of the population, by the method utilized and the segment of carotid examined. One noteworthy observation is the loss of influence of age on carotid IMT upon adjustment for the traditional and emerging risk factors among diabetic subjects and controls, there being no clear explanation for this circumstance, although it is probably due to the fact that, from the time they receive the diagnosis of their disease, the majority of diabetic individuals are being treated with statins, drugs that reduce the carotid IMT; nevertheless, it is a finding that needs to be confirmed in prospective studies.

In conclusion, the carotid IMT is greater in diabetics, but the annual increase in thickness is higher in hypertensive patients.

FUNDING

This article is based on the study entitled “Lesión de órganos diana y monitorización ambulatoria de la presión arterial (LOD-RISK)”, and its different phases and subprojects have been financed by the regional healthcare administration (GRS/47-05, GRS/167/A/07 and GRS/254/A/08), by the Consejería de Sanidad de la Junta de Castilla y León, Spain, (SAN/196/SA36/07) and by ISCIII-RETICS, cofinanced with FEDER funds (RD06/0018).

CONFLICTS OF INTEREST

None declared.

REFERENCES