Carotid atherosclerosis predicts middle cerebral artery pulsatility index: The Akershus Cardiac Examination (ACE) 1950 Study.

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BACKGROUND

Pulsatility index (PI) in the middle cerebral artery (MCA) has traditionally been considered a measure of peripheral vascular resistance, and is accordingly proposed as a marker of cerebral small vessel disease (SVD). SVD and carotid atherosclerosis represents two main causes of cerebrovascular disease.

HYPOTHESIS

In this study we hypothesized that there is an association between carotid atherosclerosis and MCA PI. Further we determined cerebral hemodynamics and cardiovascular risk factors associated with the upper levels of MCA PI.

METHODS

All residents in Akershus County, born in 1950, were invited to a cardiovascular examination in The Akershus Cardiac Examination (ACE) 1950 Study (2012-2015). The participants underwent ultrasound examination of the MCAs and the carotid arteries. Of the 3706 individuals included, 3154 (85.1%) had adequate transcranial data. Determinants of MCA PI were assessed by regression analyses adjusted for cardiovascular risk factors.

RESULTS

Baseline characteristics are presented in Table 1.

Plaque burden and cIMT were significantly associated with MCA PI, also after adjustment for established cardiovascular risk factors (Table 2, Figure 1).

Participants in the upper levels of MCA PI had lower end diastolic and mean flow velocity in the MCA, higher pulse pressure, and higher prevalence of hypertension, diabetes mellitus, and history of stroke (Table 1).

Table 1. Baseline characteristics according to MCA PI.

Deciles of MCA PI	Total	<90%	≥90%	*p*
Mean PI	0.97 (0.17)	0.93 (0.11)	1.30 (0.22)	
n	3154	2833	321	
Cardiovascular risk factors				
Female sex	1357 (43.0%)	1224 (43.2%)	133 (41.4%)	0.543
Age (years)	64 (0.6)	64 (0.6)	64 (0.7)	0.357
Obesity	685 (21.7%)	606 (21.4%)	79 (24.6%)	0.185
SBP (mmHg)	138 (18)	137 (18)	146 (21)	<0.001
DBP (mmHg)	77 (10)	77 (10)	75 (11)	<0.001
PP (mmHg)	61 (14)	59 (13)	70 (16)	<0.001
Hypertension	1957 (62.1%)	1719 (60.7%)	238 (74.1%)	<0.001
Coronary heart disease	238 (7.5%)	205 (7.2%)	33 (10.3%)	0.050
Stroke/TIA	119 (3.8%)	96 (3.4%)	23 (7.2%)	0.001
Diabetes mellitus	273 (8.7%)	227 (8.0%)	46 (14.3%)	<0.001
Hypercholesterolemi	1648 (52.4%)	1486 (52.6%)	162 (50.6%)	0.502
Current daily smoking	458 (14.5%)	407 (14.4%)	51 (15.9%)	0.463
Carotid ultrasound				
Plaque score (median(IQR))	2 (1-4)	2 (1-4)	3 (2-5)	<0.001
cIMT	0.73 (0.11)	0.73 (0.11)	0.76 (0.12)	<0.001
Echolucent plaques	491 (15.6%)	440 (15.5%)	51 (15.9%)	0.867
Transcranial Doppler				
Peak systolic velocity (cm/s)	81 (19)	81 (18)	82 (22)	0.473
End diastolic velocity cm/s)	32 (8)	33 (8)	26 (8)	<0.001
Mean flow velocity (cm/s)	49 (12)	49 (11)	45 (13)	<0.001

Table 2. Indices of carotid atherosclerosis as predictors of MCA PI.

	Model#1 B (95%CI)	Model#2 B (95%CI)	Model#3 B (95%CI)
Carotid plaque burden	0.010 (0.007-0.013)*	0.009 (0.006-0.011)*	0.007 (0.003-0.010)*
cIMT	0.212 (0.162-0.263)*	0.202 (0.151-0.253)*	0.173 (0.120-0.226)*
Echolucent plaques	0.003 (-0.013-0.019)	0.002 (-0.014-0.018)	-0.009 (-0.025-0.008)

B, beta coefficient; (95%CI), 95% confidence interval; cIMT, carotid intima-media thickness. Model #1, unadjusted; Model #2, separate models for each predictor variable, adjusted for age, sex, BMI, hypertension, hypercholesterolemia, diabetes mellitus, coronary artery disease, history of stroke/TIA, and current daily smoking.; Model #3, all predictor variables in one model, adjusted for Model #2. *p-value<0.001.

CONCLUSION

In the present study, we demonstrate a novel association between carotid atherosclerosis and MCA PI, supporting a link between two main causes of cerebrovascular disease; carotid atherosclerosis and SVD.

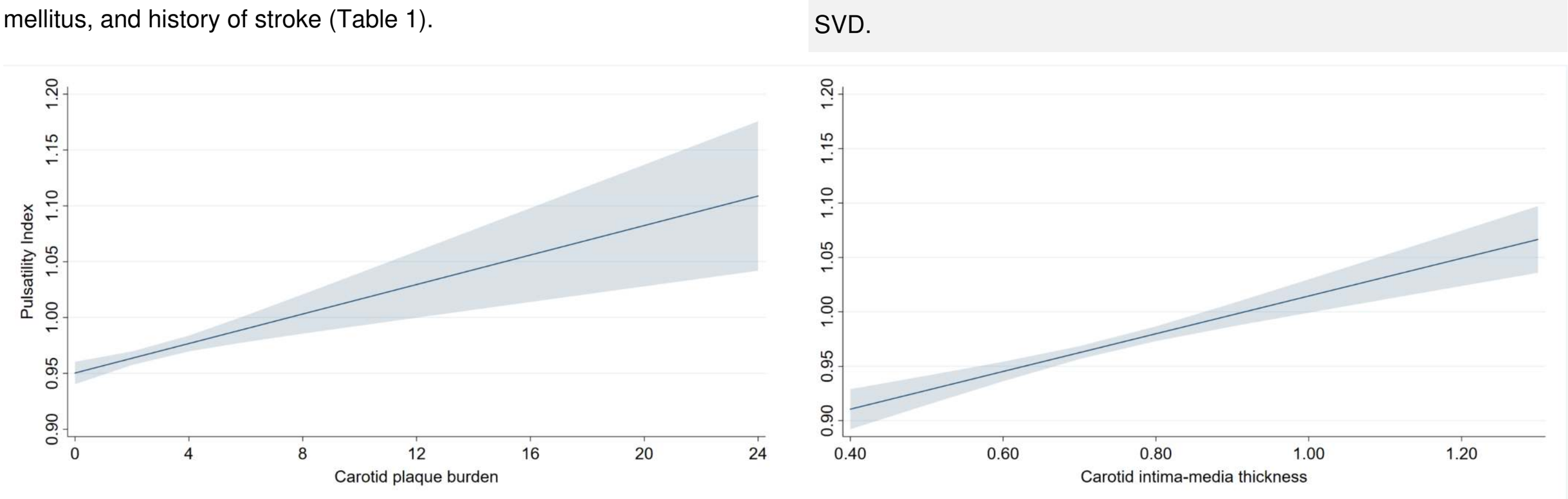

Figure 1. Adjusted linear association, with 95% confidence interval, between pulsatility index and carotid plaque burden (left), and between pulsatility index and carotid intima-media thickness (right.)