Conference Abstract

P.23 Relationship Between Aortic Stiffness, Aortic, and Carotid Impedance with Vascular Aging in Community-Based Healthy People

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ABSTRACT

Background: Stiffening of the aorta has been associated with microvascular structural brain damage and cognitive dysfunction in cross-sectional and longitudinal studies, probably due to the reduced wave reflection at the interface between carotid and aorta and transmission of excessive flow pulsatility into the brain. The present study investigated whether age-related stiffening of the proximal aorta is disproportionately greater than the carotid arteries and whether the coupling of stiffness between proximal aorta and carotid arteries affects wave reflection at the interface.

Methods: Comprehensive pulsatile hemodynamics evaluation using applanation tonometry, carotid ultrasonography and echocardiography was performed in 1236 apparently healthy community residents (age range 40 to 96 years, average 62.4 ± 10.5 years) who had no history of cardiovascular events and stroke. Aortic (Zc) and carotid (CCI) characteristic impedance were estimated in the time domain. Carotid pulsatility index (PI) was computed from the carotid flow and a carotid reflection coefficient was computed from bilateral carotid impedance and distal aortic impedance.

Results: CFPWV (Standardized Beta = 0.56, $p < 0.001$), CCI (Beta = 0.46, $p < 0.001$) and carotid reflection coefficient (Beta = 0.26, $p < 0.001$) significantly increased with age. In contrast, PI (Beta = -0.06, $p = 0.026$) significantly decreased with age, and a U-shape association between Zc (Beta = 0.09, $p = 0.002$) and age was found. Carotid flow PI was significantly related to the aorta-carotid reflection coefficient negatively ($r = -0.28$, $p < 0.001$).

Conclusions: In this healthy population, stiffening of the proximal aorta was not disproportionately greater than that of the carotid arteries. This might favorably maintain the wave reflection at the carotid-aorta interface so that carotid flow PI did not increase with age.

Table 1 | Subjects characteristics (subdivided into groups according to the age)

Age group	40~49	50~59	60~69	≧70	*p* value for trend
n = 1236	*n* = 137	*n* = 356	*n* = 445	*n* = 298	
Age (years)	45 (3)	55 (3)	64 (3)	76 (5)	<0.001
Male (male, %)	53 (41.7)	153 (43.7)	207 (47.2)	159 (55.0)	0.002
Height (cm)	162.5 (8.1)	161.5 (8.1)	159.5 (7.5)	158.3 (8.2)	<0.001
Weight (kgw)	64.0 (12.7)	64.7 (10.6)	63.0 (10.4)	62.0 (10.9)	0.004
BMI (kgw/m²)	24.1 (3.6)	24.7 (3.3)	24.7 (3.3)	24.7 (3.4)	0.31
HTN (*n*, %)	9 (7.1)	76 (21.7)	172 (39.2)	158 (54.7)	<0.001
DM (*n*, %)	5 (3.9)	32 (9.1)	78 (17.8)	71 (24.6)	<0.001
Hyperlipidiemia (*n*, %)	6 (4.7)	50 (14.3)	229 (52.2)	144 (49.8)	<0.001
Creatinine (mg/dL)	0.77 (0.45)	0.73 (0.21)	0.79 (0.27)	0.93 (0.57)	<0.001
LDL (mg/dL)	116.5 (34.8)	120.0 (35.9)	117.7 (34.1)	113.3 (35.1)	0.083
Glucose (mg/dL)	94.5 (18.1)	100.4 (21.2)	104.3 (28.2)	105.3 (26.3)	<0.001

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Table 1 | Subjects characteristics (subdivided into groups according to the age)—*Continued*

Age group	40~49	50~59	60~69	≧70	*p* value for trend
n = 1236	*n* = 137	*n* = 356	*n* = 445	*n* = 298	
Smoking (*n*, %)					0.08
Non-smoker	95 (74.8)	255 (72.9)	341 (77.7)	204 (70.6)	
Current-smoker	14 (11.0)	44 (12.6)	38 (8.7)	14 (4.8)	
former-smoker	18 (14.2)	51 (14.6)	60 (13.7)	71 (24.6)	
MMSE score < 24	0	3 (0.9)	13 (3.0)	31 (10.8)	<0.001
Echocardiography variables					
Ea (mmHg/ml)	1.86 (0.44)	1.78 (0.43)	1.70(0.43)	1.70 (0.53)	<0.001
Ees (mmHg/ml)	4.00 (1.06)	4.09 (1.06)	3.67 (1.12)	3.99 (1.73)	0.12
Ea/Ees	0.48 (0.09)	0.45 (0.09)	0.48 (0.12)	0.45 (0.13)	0.87
Stroke volume (ml)	58.5 (12.3)	64.0 (14.2)	69.5 (14.9)	72.5 (17.6)	<0.001
Cardiac index (L/min/m^2)	2.4 (0.6)	2.6 (0.6)	2.7 (0.6)	2.9 (0.8)	<0.001
Ef (%)	69.5 (6.2)	70.7 (6.4)	68.8 (7.1)	68.5 (7.9)	0.001

Data were presented as mean(SD). BMI, body mass index; HTN, hypertension; DM, diabetes mellitus; LDL, low density lipoprotein; MMSE, mini-mental state examination; Ea, arterial elastance; Ees, left ventricular end-systolic elastance; LVEDV, left ventricular end-diastolic volume; LVESV: left ventricular end-systolic volume.

Table 2 | Hemodynamics parameters (subdivided into groups according to the age)

Age group	40~49	50~59	60~69	≧70	*p* value for trend
n	*n* = 137	*n* = 356	*n* = 445	*n* = 298	
Central					
SBP (mmHg)	107.0 (16.2)	112.5 (13.9)	118.0 (15.5)	121.6 (14.9)	<0.001
DBP (mmHg)	74.3 (12.5)	77.8 (10.2)	78.8 (10.6)	77.5 (9.7)	<0.024
PP (mmHg)	33.6 (7.1)	35.5 (7.4)	40.1 (8.7)	45.3 (9.9)	<0.001
Brachial					
SBP (mmHg)	120.2 (17.3)	125.3 (15.1)	131.2 (16.8)	134.6 (16.5)	<0.001
DBP (mmHg)	73.3 (12.5)	76.8 (10.2)	77.5 (10.5)	76.1 (9.7)	0.70
PP (mmHg)	41.2 (9.1)	43.7 (11.7)	48.9 (11.7)	53.4 (12.6)	<0.001
MAP (mmHg)	90.9 (14.3)	95.0 (12.4)	98.4 (13.6)	99.9 (12.5)	<0.001
Heart rate (bpm)	69 (9.7)	69 (10.3)	66 (10.2)	66 (10.3)	<0.001
pf (mmHg)	28.8 (7.1)	28.1 (6.6)	30.2 (6.9)	34.5 (8.7)	<0.001
pb (mmHg)	14.5 (3.1)	15.4 (3.3)	17.7 (3.8)	19.5 (4.4)	<0.001
CFPWV (m/s)	9.4 (1.9)	10.8 (2.4)	12.4 (3.1)	15.2 (4.4)	<0.001
Aortic flow-pressure					
Zc (dyne·s/cm^5)	102.3 (32.2)	89.6 (31.6)	90.8 (38.4)	104.7 (50.7)	0.027
SVR (dyne·s/cm^5)	1782.0 (551.4)	1685.2 (435.7)	1683.7 (441.9)	1664.0 (543.7)	0.06
Mean flow (ml/s)	63.4 (16.6)	69.6 (19.7)	70.7 (17.4)	73.7 (20.6)	<0.001
normalized Zc	0.06 (0.02)	0.05 (0.02)	0.05 (0.02)	0.06 (0.02)	<0.001
Carotid flow-pressure					
CCI (dyne·s/cm^5)	2060.2 (520.5)	2198.2 (708.0)	3183.0 (1030.9)	3328.3 (1154.5)	<0.001
CVR (dyne·s/cm^5)	9421.3 (2472.4)	9860.9 (2049.4)	11879.2 (2612.3)	12347.4 (3022.2)	<0.001
Mean flow (ml/s)	13.2 (2.5)	13.1 (2.3)	11.2 (2.2)	10.9 (2.2)	<0.001
normalized CCI	0.22 (0.05)	0.23 (0.06)	0.27 (0.08)	0.27 (0.08)	<0.001

Data were presented as mean(SD). SBP, systolic blood pressure; DBP, diastolic blood pressure; PP, pulse pressure; MAP, mean arterial pressure; pf, forward pressure; pb, backward pressure; CFPWV, carotid-femoral pulse velocity; Zc, aortic characteristics impedance; SVR, systemic vascular resistance; CCI, carotid characteristics impedance; CVR, carotid vascular resistance.