prosound

Arterial Elasticity in Healthy Chinese

A multi-center collaborative project for the establishment of normal reference values of arterial elasticity in healthy Chinese. Measurement of the common carotid artery Elasticity in Healthy Chinese Using the *e*TRACKING Technology.

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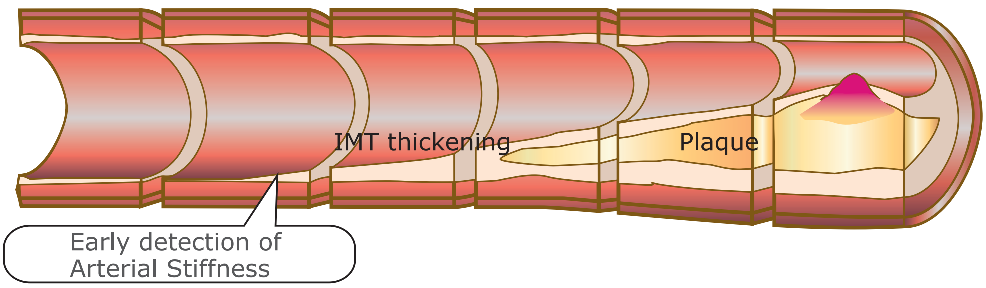
*e*TRACKING (Echo Tracking) technology, which automatically tracks vessel wall motion and measures vessel diameter, provides accurate evaluation of vascular elasticity for early diagnosis of atherosclerosis before changes in vessel wall structure or shape occur.

38 hospitals in China have committed to participating in a multi-centre collaborative project for the establishment of normal reference values of arterial elasticity in healthy Chinese.

The elasticity of bilateral common carotid artery was measured in 4,812 participants.

The obtained reference values will be of noticeable significance in the prevention of atherosclerosis, early discovery of arterial lesions and assessment of drug efficacy.



Subject

A group of 4,812 healthy Chinese subjects were enrolled in the study including 1,971 men and 2,841 women aged 5-80 years with a mean age of 33.7±10.8 years from extensive geographical coverage. Measurements of the elasticity of their common carotid arteries were made. All the subjects included were healthy Chinese non-smokers with no symptoms of valvular heart disease or arrhythmia, no abnormalities in blood lipid, glucose levels and blood pressure, and no ultra-sonographic evidence of plaque in the right subclavian artery and the common carotid artery nor increased intima-media thickness (IMT) of the carotid bifurcation (IMT $\leq$ 0.12 cm) or the common carotid artery (IMT $\leq$ 0.1 cm).

Equipment

The ProSound α 10 or ProSound SSD-5500 with *e*TRACKING technology was used to track the vessel wall motion and automatically construct the diameter change curve in real time.

ALOKA

illuminate the change

Method

- Subjects were requested to avoid heavy tea or coffee.
- Examination room : noiseless and appropriate room temperature (20-23℃).

(1) The subjects were lying flat with ECG leads attached to the body. Three measurements of the blood pressure were made with 15-minute intervals, and the mean value was documented.

(2) Long axis view of the bilateral common carotid artery were displayed by a high-frequency (13MHz) linear array probe and measured change of vessel diameter by *e*TRACKING.

(3) The sampling sites of *e*TRACKING was 2.0 cm below the inferior border of the bilateral carotid sinus.

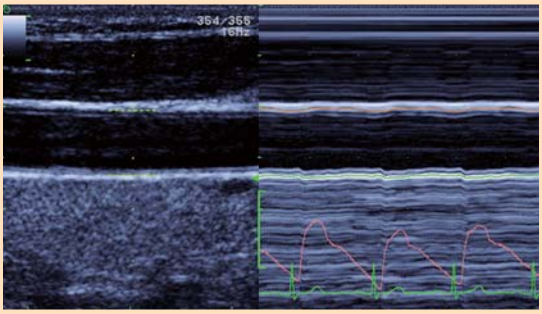
(4) The sampling gate was set to present the media-adventitia layers of both anterior and posterior walls.

(5) The subjects might have to hold their breath, if necessary, to ensure a smooth curve of the diameter changes without significant drift. At least six waveforms were acquired and five or more were analyzed.

Parameters

The five physiological parameters analyzed in the study were the stiffness (β), elastic modulus (Ep), arterial compliance (AC), augmentation index (AI) and pulse wave velocity (PWV β) of the common carotid artery.

*e*TRACKING Acquisition



Analysis screen

Statistical Analysis

Data processing was done by SPSS12.0. Mean ± standard deviation was used for measurement data. Analysis of variance was made on multi-group measurement data and t-test was made on two-group data. Linear analysis was conducted to determine the correlation between different groups. $P < 0.05$ was considered to be statistically significant.

Result

A total of 4,812 healthy Chinese were included in the analysis, and the normal reference values of arterial elasticity in seven age groups (<10 years, 10～19 years, 20～29 years, 30～39 years, 40～49years, 50～59 years and ≥60 years) were obtained.

Normal values of arterial elasticity in healthy Chinese and their changing trends

β, Ep, PWV β and AI of the common carotid artery were increasing with aging in healthy Chinese, healthy men and healthy women of each age group, while AC was contrastingly decreasing with their aging (both $P < 0.05$).
Correlation analysis revealed the best correlation between four indicators, β, Ep, PWV β and AC, of the elasticity of the carotid artery in each age group, whereas AI had relatively poor correlation with the other indicators. In addition, substantial standard deviation of AI was noticed, as well as its inconsistency with the changing trends of other indicators, in each age group. Possible explanations include potential sampling error due to inconsistent sample sizes across age groups and excessive dependence of AI values upon high resolution and stability of tracking curves. Findings of many domestic studies have also indicated that further studies are needed to determine the practical value of AI.
To sum up, β, Ep, PWV β and AC of the common carotid artery can serve as sensitive and reliable indicators of arterial elasticity; nonetheless AI is neither as sensitive nor as reliable as these indicators, and the determination of its practical value requires further studies.

Reference Value of the Elasticity in Healthy Chinese

Left Carotid Artery in 4,812 subjects (1,971 Men and 2,841 Women) by Different Age Groups（X±S）

Age group (years)	n	β	Ep	AC	PWVβ
<10	82	3.00±1.06	27.24±9.18	2.09±0.69	3.22±0.47
10~19	200	4.05±1.48	44.23±16.28	1.51±0.56	4.17±2.79
20~29	1525	5.32±1.49	63.27±18.66	1.18±0.38	4.80±0.65
30~39	1635	6.55±2.00	79.24±25.89	0.95±0.36	5.42±2.02
40~49	971	7.95±2.59	98.37±33.90	0.80±0.30	6.04±1.98
50~59	327	9.64±3.19	121.65±43.33	0.71±0.29	6.86±3.03
≧ 60	72	10.71±3.93	136.58±49.48	0.73±0.30	6.99±1.42

Left Carotid Artery in 1,971 Men by Different Age Groups（X±S）

Age group (years)	n	β	Ep	AC	PWVβ
<10	51	3.18±1.17	28.63 ±9.73	2.10±0.78	3.29±0.49
10~19	103	3.98±1.33	44.04 ±17.17	1.59±0.61	4.29±3.81
20~29	732	5.26±1.44	64.97±18.65	1.21±0.39	4.84±0.65
30~39	593	6.47±1.79	81.51±24.19	0.98±0.38	5.53±2.33
40~49	320	8.16±2.67	103.83±35.75	0.82±0.31	6.14±1.06
50~59	122	9.41±2.92	121.42±41.18	0.72±0.29	7.17±4.73
≧ 60	50	10.23±3.40	134.10±47.10	0.79±0.31	6.84±1.41

Left Carotid Artery in 2,841 Women by Different Age Groups（X±S）

Age group (years)	n	β	Ep	AC	PWVβ
<10	31	2.70±0.79	24.97±7.83	2.07±0.54	3.10±0.43
10~19	97	4.13±1.62	44.42±15.36	1.43±0.49	4.03±0.82
20~29	793	5.37±1.53	61.71±18.54	1.15±0.37	4.76±0.66
30~39	1042	6.60±2.11	77.95±26.74	0.93±0.35	5.36±1.82
40~49	651	7.85±2.54	95.69±32.65	0.80±0.30	5.99±2.29
50~59	205	9.78±3.35	121.79±44.65	0.70±0.29	6.67±1.13
≧ 60	22	11.80±4.84	142.21±55.26	0.59±0.22	7.31±1.44

Right Carotid Artery in 4,812 subjects (1,971 Men and 2,841 Women) by Different Age Groups（X±S）

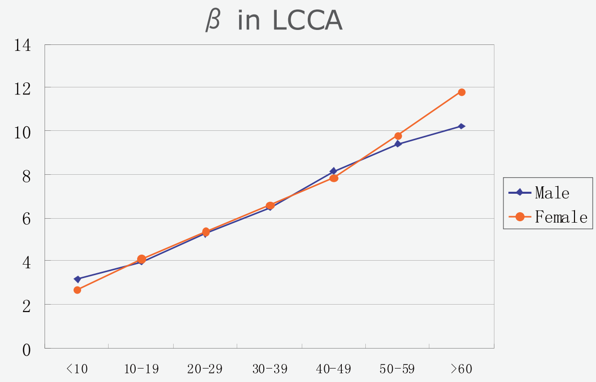
Age group (years)	n	β	Ep	AC	PWVβ
<10	82	3.19±0.96	29.18±9.36	2.08±0.69	3.32±0.49
10~19	200	4.30±1.43	47.12±17.69	1.51±0.53	4.11±0.74
20~29	1525	5.73±1.94	68.04±22.93	1.14±0.40	4.99±1.32
30~39	1635	6.80±2.27	82.29±29.84	0.94±0.33	5.58±2.49
40~49	971	7.93±2.67	97.72±35.51	0.82±0.29	6.10±2.61
50~59	327	9.73±3.33	122.93±44.64	0.71±0.26	6.85±3.85
≥60	72	10.86±4.40	140.73±60.99	0.75±0.31	7.07±1.39

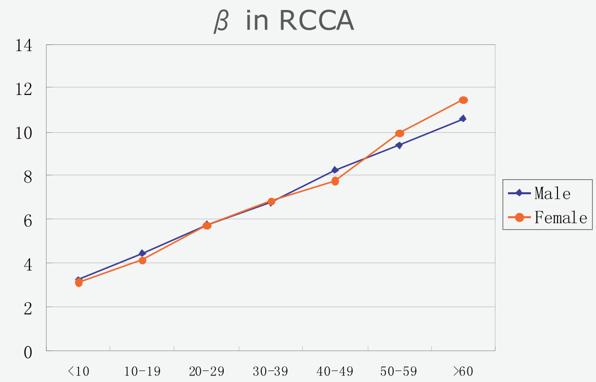
Right Carotid Artery in 1,971 Men by Different Age Groups（X±S）

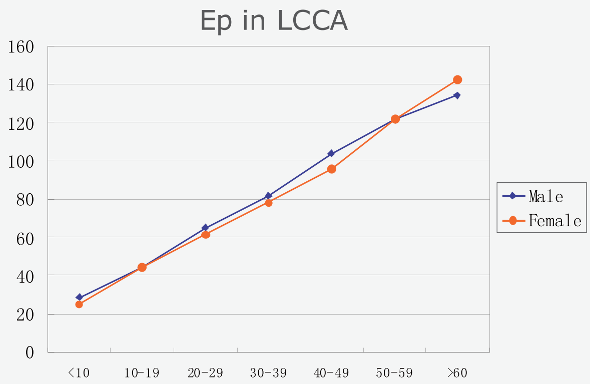
Age group (years)	n	β	Ep	AC	PWVβ
<10	51	3.23±0.99	29.29±9.22	2.13±0.71	3.32±0.48
10~19	103	4.45±1.40	48.71±17.16	1.49±0.53	4.12±0.64
20~29	732	5.74±2.08	70.42±24.35	1.15±0.37	5.07±1.77
30~39	593	6.77±2.24	85.67±30.06	0.96±0.31	5.88±3.93
40~49	320	8.23±2.93	104.17±38.74	0.83±0.30	6.34±3.22
50~59	122	9.38±3.49	121.82±47.91	0.76±0.30	7.13±6.16
≥60	50	10.60±4.38	137.82±59.22	0.82±0.33	7.00±1.41

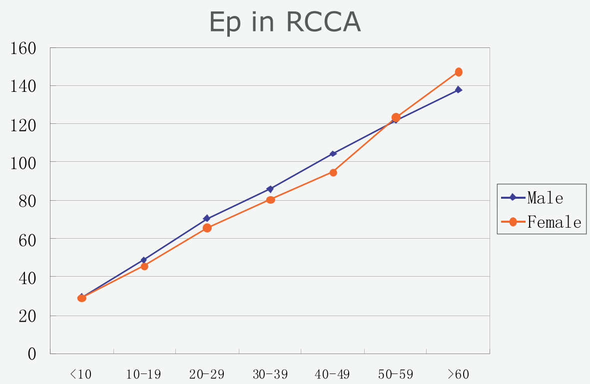
Right Carotid Artery in 2,841 Women by Different Age Groups（X±S）

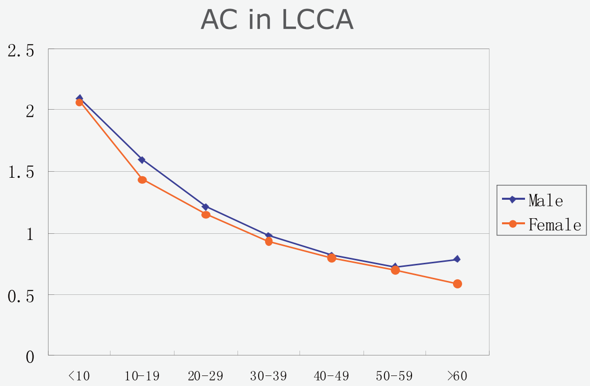
Age group (years)	n	β	Ep	AC	PWVβ
<10	31	3.13±0.92	29.00±9.73	2.01±0.66	3.31±0.51
10~19	97	4.14±1.44	45.43±18.17	1.53±0.53	4.09±0.83
20~29	793	5.73±1.80	65.84±21.30	1.13±0.41	4.92±0.68
30~39	1042	6.82±2.29	80.37±29.56	0.93±0.33	5.40±0.92
40~49	651	7.79±2.53	94.55±33.38	0.82±0.28	5.99±2.24
50~59	205	9.94±3.23	123.59±42.68	0.68±0.23	6.69±1.06
≥60	22	11.47±4.50	147.34±65.78	0.61±0.19	7.23±1.36


β in LCCA
14
12
10
8
6
4
2
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


β in RCCA
14
12
10
8
6
4
2
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


Ep in LCCA
160
140
120
100
80
60
40
20
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


Ep in RCCA
160
140
120
100
80
60
40
20
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


AC in LCCA
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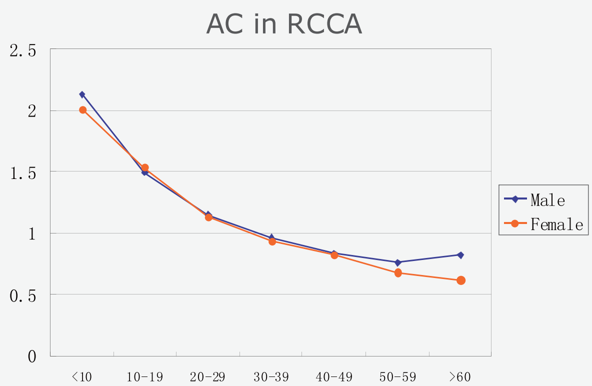
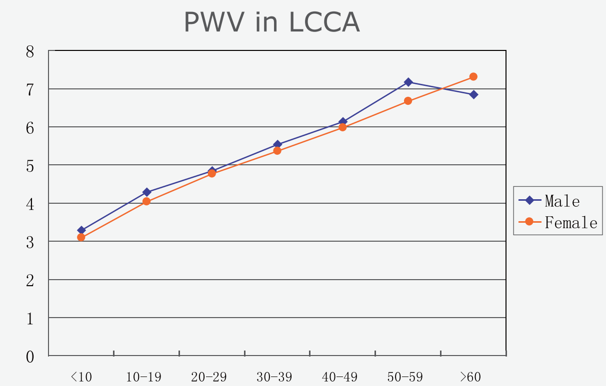
2
1.5
1
0.5
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


AC in RCCA
2.5
2
1.5
1
0.5
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


PWV in LCCA
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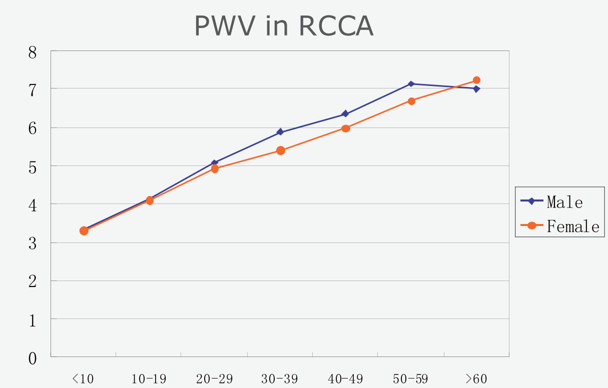
7
6
5
4
3
2
1
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female


PWV in RCCA
8
7
6
5
4
3
2
1
0
<10
10-19
20-29
30-39
40-49
50-59
>60
Male
Female

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