Aortic Compliance in Normals Correlates with Age and BMI

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Aortic compliance (AC) can be evaluated noninvasively and its reduction with age in normals has been demonstrated with MRI. Decreased AC is also associated with systolic hypertension and left ventricular diastolic dysfunction. Aortic pulse wave velocity (PWV) often serves as a surrogate to AC, and can be evaluated using a single breath-hold phase contrast imaging technique. Its age correlation has been demonstrated by both MR and Doppler studies in normal volunteers. We evaluated aortic compliance and its relationship to age, and other clinical parameters in a large population of normal volunteers.

MATERIAL AND METHODS

Healthy volunteers with informed consent (Total of 189, age: 58.1±14.7, 108 female) with BMI 28 or less were screened to exclude hypertension, diabetes and cardiovascular disease. Using the 'candy cane' view of aorta, an axial plane through the ascending and descending aorta at the pulmonary artery level was prescribed and through-plane selocity encoded phase contrast imaging performed with VENC of 150 cm/s, TR/TE/FA = 98ms/2.9ms/15° and voxel spatial resolution 1.3×2×6 mm^3 on a 1.5T MRI scanner. Cardiac volumetric results were obtained using short axis 2D cine SSFP acquisitions with 35 ms temporal resolution and no gap between slices. The distance traveled by the aortic pulse wave, ΔD, was determined as the distance along the centerline between ascending and descending aorta in the 'candy cane' image. To determine the time interval of flow wave travel between ascending and descending aorta, we used a cross correlation algorithm. The cross correlation between the first half of ascending and that of descending aortic flow curves was calculated by varying the relative time between them. The Δt was the time shift at the maximal correlation.

We then calculated $PWV=\Delta D/\Delta t$ and aortic compliance as $AC=1/(\rho*PWV^2)$, where blood density ρ=1057kg/m. The Pearson correlation coefficient was used to evaluate e relationships between AC and age, body mass index (BMI), diastolic blood pressure (DP), systolic blood pressure (SP), mean arterial pressure (MAP), heart rate, rate pressure product (RPP), and left ventricular volume indices and ejection fraction.

RESULTS

The mean±sd value of AC was $(3.68±4.35)*10^{-5}$/Pa, $(3.81±4.89)*10^{-5}$/Pa for 108 female cases, and $(3.51±3.54)*10^{-5}$/Pa for 81 male cases, respectively, p=ns. There was no significant difference in RPP between males and females either. However, men were heavier (BMI 25.1±2.5 vs. 23.0±2.7, p<0.001), younger (age 55.8±14.1 vs. 59.8±14.9, p=0.06) than women in our study population and their mean blood pressure was higher (MAP 95.2±9.3 vs. 87.8±10.0, p<0.001). As illustrated in the **Figure,** aortic compliance correlated with volunteers' age. The AC relationship with age was stronger in women than in men and AC also was weakly correlated with BMI in women but not in men, as shown in **Table**.

CONCLUSION

Aortic compliance in normal volunteers using the through-plane phase contrast imaging technique showed a good correlation with age. This imaging technique permits evaluation of aortic compliance in a single breath-hold and has the potential to be an efficient clinical tool for assessment of vascular stiffness. Studies of healthy individuals with higher BMI will be required to further define the BMI-AC relationship.

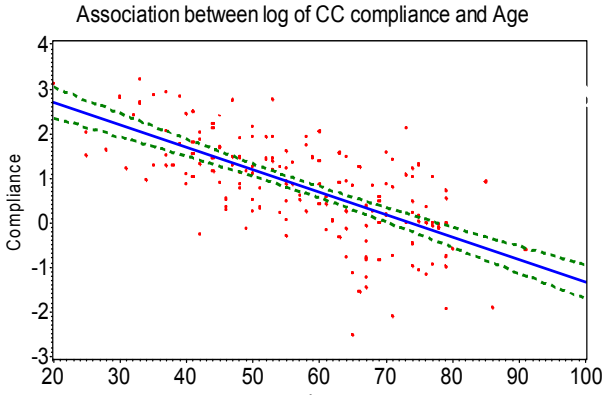

Figure. Aortic compliances vs age regression curve: Compliance = 14.37518 - 0.182261*Age

	Age	BMI	DP mmHg	SP mmHg	MAP mmHg	RPP	LV ESVi
Mean±SD Total (**N=189**)	58.1 ±14.7	23.9 ±2.7	73.6 ±9.4	125.7 ±16.3	91.0 ±10.3	133.6 ±28.9	32.8 ±9.6
AC Correlation Total (**N=189**)	-0.59 p<.0001	-0.14 P=0.057	-0.18 P=0.013	-0.30 p<.0001	-0.27 P<0.001	-0.22 P=0.021	0.14 P=0.042
AC Correlation Female (**N=108**)	-0.91 p<.0001	-0.20 P=0.042	-0.15 P=0.11	-0.31 P=0.001	-0.27 P=0.005	-0.29 P=0.002	0.22 P=0.021
AC Correlation Male (**N=81**)	-0.48 p<.0001	-0.02 P=0.84	-0.24 P=0.032	-0.27 P=0.014	-0.29 P=0.009	-0.09 P=0.42	0.15 P=0.16

Table. Pearson correlation between aortic compliance vs. age and other clinical parameters, for all subjects and by gender