Age-related changes in the biomechanical strain of the human thoracic aorta

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PURPOSE Previous studies of aortic wall biomechanics focused on circumferential motion and strain. We have developed a novel method that allows for the determination of both longitudinal and circumferential strain. The purpose of this study is to quantify the age-related changes in the biomechanics of the human thoracic aorta.

METHODS Changes in thoracic aortic length, diameter, and deformation were quantified using 4D cardiac-gated CT imaging in fourteen patients, aged 36-83, with no aortic pathology. Arch length was defined along the vessel centerline from the left carotid artery (LCA) to the first intercostal artery (ICA). The descending thoracic aorta (DTA) length was defined along the vessel centerline from the first to seventh ICA. Diameters were computed at the first (proximal) and seventh (distal) ICA ostia. Longitudinal [and circumferential] strains were calculated as the change between systolic and diastolic length [diameter] divided by the diastolic length [diameter]. We compared the results of seven young (age 43±6 yrs, 5M, 2F) and seven old (age 69±9 yrs, 5M, 2F) patients.

RESULTS The aortic arch length increased 14% from young to old patients (133±18mm versus 152±9mm, p=0.02) with a similar increase in the proximal diameter (23.3±1mm versus 26.7±4mm, p=0.002) and a 10% increase in the distal diameter (21.6±1mm versus 23.6±3mm, p=0.006). Longitudinal strain decreased by 55% from young to old patients (2.2±0.7% versus 1.0±0.6%, p=0.03). Circumferential strain in the proximal aorta decreased 74% (8.5±2% versus 2.2±2%, p=0.001), while in the distal aorta it decreased 64% (9.0±3% versus 3.2±1%, p=0.002).

SIGNIFICANCE Age-related changes of the thoracic aorta include a significant increase in length and diameter, along with a decrease in longitudinal and circumferential strain. This represents the first quantitative description of *in vivo* longitudinal strain and length changes for the human thoracic aorta and may have significant implications in long-term endoaortic device stability.

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