# Regional curvature in thoracic aortic aneurysms of different aetiologies and its relationship with established risk factors

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**Introduction:** The aorta is a 3D hollow, curvilinear elastic structure whose diseases have life-threatening consequences. Despite much effort has been paid to study aortic diameter, diameter is a poor predictor of events. Conversely, much less is known about aortic curvature, its distribution in the thoracic aorta and the potential impact of risk factors in aneurysms associated with different conditions. Currently, 4D flow magnetic resonance imaging (4D flow CMR) allows to obtain 3D geometry, 4D flow data and regional aortic stiffness.

**Purpose:** We aim to study regional aortic curvature in thoracic aorta aneurysms of different aetiologies and define its relationship with established risk factors.

**Methods:** One-hundred twenty patients (40 for each group, selected out of prospective cohorts of 156 bicuspid aortic valve – BAV-, 77 Marfan –MFS- and 67 patients with a degenerative aneurysm – TAVdeg-) were matched for age, sex and BSA via propensity score with 40 healthy volunteers (HV). The thoracic aorta was semi-automatically segmented from angiograms and the centreline was computed. Local curvature was assessed at 20 planes covering the thoracic aorta from the sinotubular junction to the proximal descending aorta (DAo) at the level of the pulmonary artery bifurcation. Local curvature was normalized by subject mean thoracic aorta curvature. Length was measured as centreline length. Aortic stiffness was measured in the DAo by pulse wave velocity (PWV). Aneurysm was defined by z-score ≥ 2 using diameters measured by double-oblique cine CMR.

**Results:** Matching was successful in all groups with the exception of a residual age difference between HV and TAVdeg. Curvature in HV showed a fairly smooth transition between the straighter ascending aorta (AAo) and DAo to a more curved aortic arch, with a peak in the mid aortic arch (Figure 1A). Conversely, all patients' groups presented a peak in curvature in the proximal DAo and a decreased local curvature in the aortic arch and mid DAo close to the level of the pulmonary artery. BAV and TAVdeg patients showed also increased curvature in the mid AAo, were dilation is prevalent. Conversely, in the same area MFS showed a reduced curvature and limited prevalence of aneurysm. In the overall population, age, AAo and root diameters, mean blood pressure, DAo PWV and aortic length, all established risk factors for aortic events, were inversely related to curvature in the distal AAo and aortic arch (Figure 1B).

**Conclusions:** Aneurysms related to different aetiologies show similar abnormalities in aortic curvature, with limited curvature in the aortic arch and a peak soon after the third supra-aortic vessel. Age, aortic diameter, length, stiffness and blood pressure, all known risk factors, are all related to reduced curvature in the distal ascending aorta and aortic arch.

Abstract Figure.