The length of the fusion between leaflets in bicuspid aortic valve is independently related to ascending aorta dilation and flow dynamics alterations assessed by 4D-flow CMR

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Background: Aortic dilation in bicuspid aortic valve (BAV) patients has been related to altered flow patterns, which contribute to aortic wall degeneration. However, preventive aortic replacement is currently based on a diameter threshold. Several studies on excised BAV reported wide variability of fusion extent.

Purpose: To unveil whether leaflet fusion extent can be quantified by CMR and is related to aortic dilation and flow abnormalities in non-dysfunctional BAV.

Methods: One hundred and twenty adults with non-dysfunctional BAV and no previous aortic or aortic valve surgery and 28 healthy volunteers underwent double-oblique cine and 4D flow CMR. BAV patients with two sinuses of Valsalva or left and non-coronary cusps fusion were excluded. Peak systolic circumferential wall shear stress (WSSc) and pulse wave velocity (PWV) in the ascending aorta (AAo) were assessed by 4D flow CMR. Fusion length between leaflets was measured using a stack of double-oblique cine CMR images of the aortic valve.

Results: The length of the fusion was effectively measured in 112/120 (93%) patients with good reproducibility (ICC = 0.826) and showed great variability (range 2.3–15.4 mm, 7.8±3.2 mm and tertiles cut-off points 6 and 9.3 mm). In multivariate analysis adjusted for clinical and demographic characteristics and PWV, fusion length was independently associated with the diameter at the sinus of Valsalva (p=0.002) and the AAo (p=0.02) (Table). WSSc progressively increased with larger fusion length (Figure), with statistical significance ($p<0.05$) in the right and outer regions of the proximal and mid AAo.

Conclusions: Bicuspid aortic leaflet fusion length varies considerably, and it is independently associated with AAo and aortic root dilation, possibly through flow alterations.

Table 1. Multivariate analyses for aortic sinus and ascending aorta diameters

	Aortic sinus diameter p-value	AAo diameter p-value
Sex (% male)	–	–
Age (years)	0.005	0.001
Body surface area (m^2)	0.003	–
Stroke volume (ml)	0.014	0.003
Systolic blood pressure (mmHg)	–	–
Diastolic blood pressure (mmHg)	–	–
AAo PWV (m/s)	–	<0.001
Right-non coronary fusion BAV	0.002	–
Fusion length (mm)	0.002	0.028

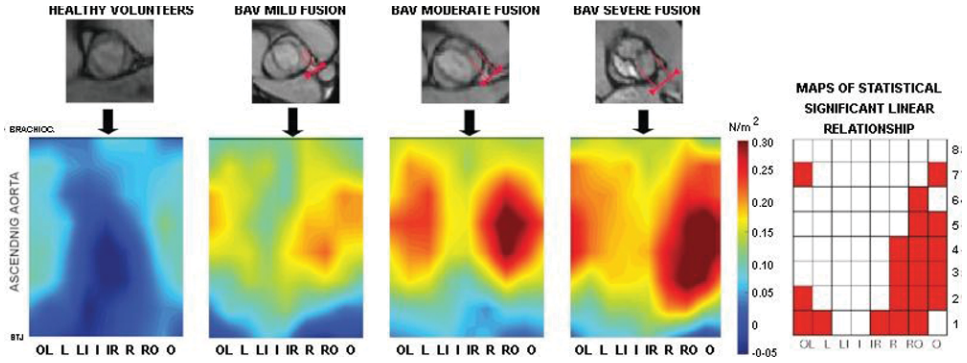

Figure 1. Maps of circumferential WSS