

Abstract 107 Figure 1

Conclusions An expanding RDW and evolving iron deficiency over time predict an amplified risk of death in CHF and could be utilised for risk stratification or therapeutically targeted to improve outcomes.

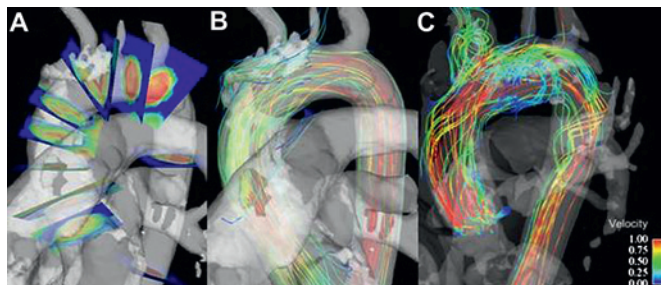
108 4D-FLOW CMR DEMONSTRATES THE REGIONAL DISTRIBUTION OF AORTIC FLOW DISTURBANCE IN MARFAN SYNDROME

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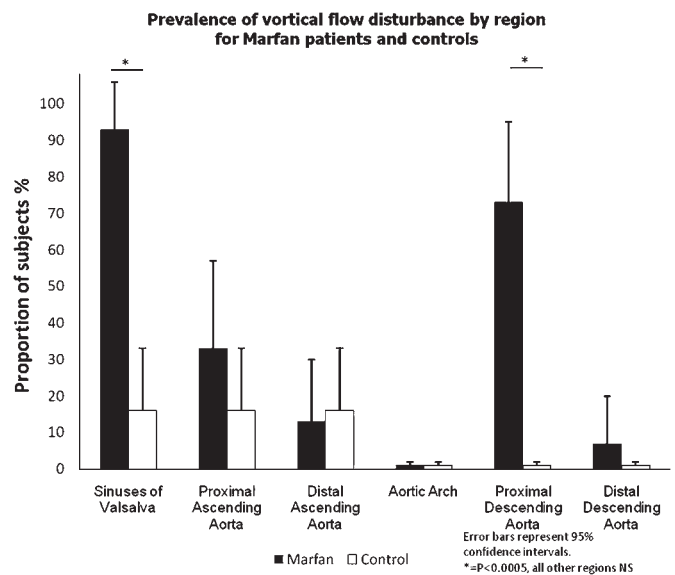
Background Marfan syndrome (MFS) commonly leads to progressive aortic dilation, aneurysm formation and aortic dissection, particularly at the aortic sinuses (~60% of dissections), and descending thoracic aorta (~30% of dissections). Abnormal aortic blood flow patterns may contribute to the enlargement and dissection of an inherently weak aorta, or to late complications after aortic dissection.

Methods 18 patients with MFS (3 with a prior history of aortic dissection and aortic root surgery, 15 with no such history) and 18 healthy volunteers matched for age, sex and height underwent CMR at 3T, using a time-resolved 3-dimensional flow technique. The aorta was segmented into regions on the basis of anatomic features (Abstract 108 figure 1A). Each segment was visualised using streamlines (Abstract 108 figure 1B) and particle traces, and was rated as normal or abnormal, (defined as the presence of turbulent flow vortices) and, where abnormal, extent of abnormality was classified on a 4-point scale determined by the extent of radial involvement of the aortic lumen. Wall shear stress (WSS) quantification was undertaken at predefined aortic locations (Abstract 108 figure 1A).



Abstract 108 Figure 1 A. Planes for aortic segmentation and WSS quantification. B. Flow visualisation in a healthy volunteer. C. Flow visualisation in a patient with prior aortic dissection fulfilling the Ghent Criteria for Marfan syndrome.

Results Significant vortical flow in any segment (defined as flow disturbance occupying more than one half of the aortic lumen) was present in all patients with MFS, but in only 7/18 controls ($p < 0.0005$). The severity of flow disturbance was greater in MFS patients than controls (median severity score 3 for Marfan patients, 1 for controls, $p < 0.0005$). There was marked regional variation in the prevalence of major flow disturbance (Abstract 108 figure 2), with the sinuses of Valsalva and proximal descending aorta being most frequently affected. Prior repaired aortic dissection was associated with marked abnormalities of blood flow (Abstract 108 figure 1C), with corresponding increases in axial WSS within the true lumen of the dissected aorta (typical axial WSS in the dissected ascending aorta was $+0.9 \text{ N/m}^2$, compared to $+0.54 \text{ N/m}^2$ in healthy controls). Aortic flow disturbance in MFS was of one of three types: Type A: flow disturbance confined to the sinuses of Valsalva, Type B: flow disturbance confined to the proximal descending aorta, Type C: flow disturbance in both the sinuses of Valsalva and the proximal descending aorta.



Abstract 108 Figure 2 Prevalence of vortical flow disturbance occupying $>50\%$ luminal diameter for each aortic region for Marfan patients and controls.

Conclusion Patients with MFS commonly show aortic flow disturbance. The sinuses of Valsalva and proximal descending aorta are most frequently affected. Flow disturbance can be categorised into one of three categories, and we anticipate that flow abnormalities within a segment will predict progressive aortic dilation and dissection in an ongoing follow-up study.

109 3T MRI OF ACUTE ATHEROSCLEROTIC PLAQUE RUPTURE AND DOWNSTREAM EMBOLIC INJURY

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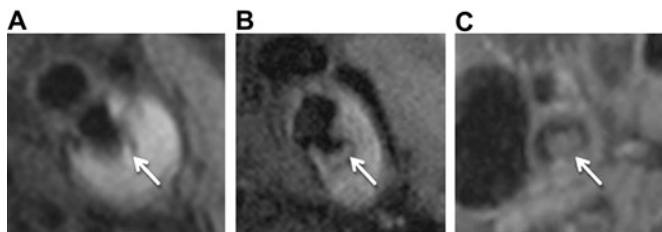
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Introduction Luminal stenosis is a poor predictor of the risk posed by any given atherosclerotic plaque, therefore current angiographic imaging techniques cannot reliably determine which patients are most likely to suffer future ischaemic events. However, MRI may be able to detect features of atherosclerotic plaque rupture that have been associated with an increased risk of recurrent atherothrombosis.

Hypothesis 3T MRI of the carotid artery can identify atherosclerotic plaque rupture in patients presenting with TIA or minor stroke.

Methods 81 patients with carotid artery disease were recruited; 41 presented acutely with TIA or minor stroke and 40 asymptomatic patients acted as the control group. Median time from symptom onset to MRI in the symptomatic group was 2.1 days (range 0.17–7.0). All patients underwent T1, T2 and proton density-weighted turbo spin echo MRI to 10 mm either side of the carotid. As part of a combined scan protocol, study participants then underwent diffusion-weighted imaging (DWI) and Fluid-Attenuated Inversion Recovery (FLAIR) imaging of the brain to assess acute and chronic injury, respectively. If physically able, patients underwent follow-up scanning a minimum of six weeks later. Plaques were graded according to the MRI modified American Heart Association (AHA) system by two independent reviewers blinded to the clinical status of the patient. Statistical analysis was performed using the Wilcoxon sign rank test and Fisher's exact test to compare plaques, in addition to the Mann Whitney U test to compare cerebral injury.

Results AHA type VI (ruptured) plaque was seen in 22/41 (54%) in the symptomatic group vs 8/41 (20%) in the asymptomatic group ($p<0.05$), either due to intra-plaque haemorrhage (34% vs 18%, $p=0.08$; Abstract 109 figure 1A), surface rupture (24% vs 5%, $p=0.03$; Abstract 109 figure 1B), or luminal thrombus (7% vs 0%, $p=0.24$; Abstract 109 figure 1C). Of particular note, 17/30 (57%) cases of AHA VI (ruptured) plaque were seen to cause $<70\%$ stenosis—the current cut-off for surgical treatment. At follow-up scanning a minimum of 6 weeks later, only two cases of AHA VI plaque showed evidence of full healing. Of the 41 patients in the acute group, evidence of cerebral injury on DWI imaging was seen in 32/41 patients; the median number of lesions per patient was 7 and the median total lesion volume was 10.62 ml (range 0–522 ml). No significant associations were noted between AHA plaque type and downstream cerebral injury, however the presence of plaque surface rupture independently predicted a higher number of DWI lesions, a higher total DWI burden at presentation, and higher total cerebral FLAIR signal at follow-up when compared to all other plaque types ($p<0.05$).



Abstract 109 Figure 1

Conclusion Acute atherosclerotic plaque rupture can be visualised using 3T MRI. In particular, MRI can provide detailed information on plaque morphology that can predict downstream embolic injury, independent of the degree of luminal stenosis caused.

110 MYOCARDIAL SYSTOLIC STRAIN AND SUBCLINICAL ATHEROSCLEROSIS IN YOUNG ADULT LIFE

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Background In the elderly, reduced left ventricular function is related to elevated carotid intima media thickness (IMT), a well-established subclinical marker of atherosclerosis. Cardiovascular magnetic resonance (CMR) allows for precise quantification of changes in myocardial structure and function. We therefore sought to determine if in young adults, without overt cardiovascular risk factors,

there was already evidence of early changes in systolic function related to subclinical atherosclerosis.

Methods We studied 81 individuals (44 females, 37 males) without cardiovascular risk factors and with a mean age of 28.42 ± 5.36 years (mean \pm SD). Peak mid-ventricular myocardial circumferential systolic strain and left ventricular mass adjusted for body surface area (LVM) were assessed by CMR. Carotid IMT was measured as a marker of subclinical atherosclerosis using ultrasound. Demographic and anthropometric characteristics were measured as well as metabolic parameters and peripheral and central blood pressure.

Results Individuals with reduced peak myocardial circumferential systolic strain had higher carotid IMT ($r=0.392$, $p<0.001$). Total cholesterol level and waist to hip ratio were both significantly associated with reduced myocardial strain. Increased LVM, central and peripheral systolic blood pressure, peripheral pulse pressure, glucose, triglycerides, age, body mass index and waist to hip ratio, as well as reduced high-density lipoprotein, were all significantly associated with increased carotid IMT ($p<0.01$). Males also had higher carotid IMT than females (mean \pm SD = 0.54 ± 0.068 mm vs 0.47 ± 0.042 mm, $p<0.001$). The association between carotid IMT and peak myocardial circumferential systolic strain was independent of gender, smoking, LVM as well as peripheral and central blood pressure measures.

Conclusions We have shown for the first time that subclinical changes in cardiac function and subclinical atherosclerosis are closely interrelated in young adults, with associations that extend to those in the normal range of cardiovascular risk. This study further establishes the ability of CMR to detect early changes in cardiovascular disease development.

111

SINGLE CENTRE PROSPECTIVE CARDIAC CT STUDY TO DETERMINE THE PREVALENCE OF PATIENTS WITH CORONARY ARTERY DISEASE WITH A ZERO CORONARY ARTERY CALCIUM SCORE AND ASSOCIATED NON-CARDIAC INCIDENTAL FINDINGS

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Introduction Cardiac CT, incorporating coronary artery calcium (CAC) scoring and angiography, is being increasingly used to evaluate patients with chest pain and exclude coronary artery disease (CAD), as recommended in the recent NICE guidelines. Calcification of the coronary arteries is an excellent marker of underlying atherosclerosis, but a zero CAC score does not completely exclude the diagnosis as potentially significant non-calcified plaques will not be detected by CAC scoring. CT imaging may also identify non-cardiac incidental findings that can lead to further downstream testing and medical expense.

Objectives (1) To evaluate the probability of CAD in patients with a CAC score of zero. (2) To determine the incidence of non-cardiac incidental findings on cardiac CT and to quantify resulting investigations.

Methods 116 symptomatic patients undergoing cardiac CT to exclude CAD from November 2009 to October 2010 were prospectively enrolled. Patients underwent CAC scoring and had contrast-enhanced, 128-slice, dual source CT coronary angiography (CTCA—Siemens Flash). Scans were dual-reported by a cardiac radiologist and a cardiologist. Statistical analysis was performed using GraphPadPrism.

Results 62/116 patients had a CAC score of zero. Of these, 57 (91.9%) patients had normal coronary arteries, 4 (6.5%) patients had non-obstructive CAD (stenosis $<50\%$), and 1 patient (1.6%) had significant obstructive CAD (stenosis $>50\%$). This patient with obstructive CAD had a high grade lesion in the proximal left anterior descending artery that required intervention. 54/116 had non-zero CAC scores. Of these, 13 (24%) had obstructive CAD and 41 (76%) non-obstructive CAD. 42/116 (36%) patients had incidental findings on