

Aortic Pulse Wave Velocity as an Indicator of Cardiovascular Risk in Type-2 Diabetes

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Background: Type-2 diabetes mellitus (T2DM) is an established cardiovascular risk factor affecting at least 180 million people worldwide. Arterial stiffness is an established predictor of cardiovascular risk which can be estimated indirectly by pulse wave velocity (PWV). Cardiac MRI is well suited for assessing aortic stiffness and can provide a regional PWV measurement. The aim of this study was to employ cardiac MRI to simultaneously examine aortic PWV and left ventricular (LV) function in a heterogeneous T2DM population, with and without symptomatic CVD.

Methods: A cohort (n= 88) comprising of 4 sub-groups; T2DM with CVD (G1: n=23), T2DM without CVD (G2: n=29), CVD without T2DM (G3: n=19) and a control group (G4: n=19) were scanned on 3T Magnetom Trio MRI scanner (Erlangen, Germany). The protocol consisted of (i) standard clinical LV assessment using 2D ECG gated, segmented TrueFISP with slice thickness 6mm and 4mm gap made with a series of short-axis plane images from the atrioventricular ring down to the apex. Quantitative measures were performed by segmenting the endocardial and epicardial myocardial borders (ARGUS software). (ii) Aortic PWV was determined by applying phase contrast MRA (PC-MRA) at the aortic arch and the descending aorta. Imaging parameters included: echo time of 4.83 ms, repetition time of 14 ms, flip angle 20°, slice thickness of 8 mm, field of view at 350 mm, matrix size 256 x 256. The temporal resolution was optimised to ensure that 128 phases per cardiac cycle were obtained and a VENC of 150cm/sec. Image processing performed using Segment v1.9 R1917 (Heiberg, Germany). The transit time and the distance between each measurement plane were used to elicit PWV.

Results: Aortic PWV was found to be significantly elevated in patients with CVD (G1: $8.7 \pm 2.8\text{ms}^{-1}$, G3: $8.9 \pm 3.6\text{ms}^{-1}$) compared to healthy controls (G4, $6.7 \pm 1.8\text{ms}^{-1}$, $p<0.05$) but it did not differ significantly in T2DM participants (G2: $7.5 \pm 2.3\text{ms}^{-1}$, $p=0.32$). LVM was significantly increased in the CVD groups (G1, $62.5 \pm 10.4\text{gm}^{-2}$, G3, $61.5 \pm 10.9\text{gm}^{-2}$ relative to healthy controls; G4, $51.5 \pm 5.3\text{gm}^{-2}$, $p<0.05$). Although not significant, LVM showed a weak positive correlation with PWV ($\rho = 0.12$, $p=0.27$). For other clinical parameters, PWV showed significant correlations with age, hypertension and systolic blood pressure ($p<0.05$). However, factors such as BMI, smoking status, gender or duration of diabetes did not show a significant correlation with PWV.

Conclusion: In this study, aortic stiffness and cardiac function were simultaneously acquired in a comprehensive cardiac MRI protocol. This study differs from other MRI studies as it involves a heterogeneous complicated diabetic population with and without symptomatic CVD. Elevated PWV and LVM were seen across all patient groups compared to healthy controls and these were significantly associated with CVD.

Table 1: Aortic PWV and LV parameters for each of the groups with and without CVD and/ or T2DM

Cardiac MRI data	Group 1 CVD & T2DM n=22	Group 2 T2DM n=28	Group 3 CVD n=19	Group 4 Controls n=19	ANOVA Sig. P-value
PWV (ms^{-1})	8.7 ± 2.8	7.5 ± 2.3	8.9 ± 3.6	6.7 ± 1.8	* $p=0.042$
LVM (gm^{-2})	62.5 ± 10.4	56.8 ± 12.0	61.5 ± 10.9	51.5 ± 5.3	** $p=0.004$