The association between native myocardial T1 relaxation times and left atrial phasic structure and function: the UK Biobank Imaging Enhancement study

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Funding Acknowledgement: Type of funding sources: Public hospital(s). Main funding source(s): This work was part of the portfolio of translational research of the National Institute for Health Research Biomedical Research Centre at Barts and The London School of Medicine and Dentistry. Dr Nay Aung is supported by a Wellcome Trust Research Training Fellowship (203553/Z/16/Z).

Introduction: Left ventricular (LV) myocardial fibrosis is posited to result in left atrial (LA) changes via LV remodelling and diastolic dysfunction, though the association remains poorly characterised. Native myocardial T1 mapping is a non-invasive modality that quantifies diffuse myocardial fibrosis. This study examines the relationship between LV fibrosis (quantified by native T1 times) and LA function, drawing upon data from the UK Biobank.

Methods: 40,818 participants underwent cardiovascular magnetic resonance (CMR) using steady-state free precession imaging at 1.5 Tesla. Native T1-mapping was performed using the Shortened Modified Look-Locker Inversion recovery technique (ShMOLLI), with global myocardial T1 estimated by an automatic segmentation framework. Nine parameters of LA phasic function were calculated (representing global, reservoir, conduit and booster components) from normalised LA volume-time curves. LV parameters (LV Mass, end-diastolic volume and ejection fraction) were extracted by a convolutional neural network. Multivariable logistic regression models were used to assess the association between T1 (exposure) and LA function (outcome). Mediation analysis was performed to assess the role of LV parameters as a mediator for the association between T1 and LA function. Lastly, potential non-linear relationships between T1 and LA function were investigated using Restricted Cubic Spline (RCS) modelling, with model fit assessed via the Akaike Information Criterion (AIC).

Results: Higher T1 values were positively associated with larger LA volumes, and negatively associated with markers of LA global, reservoir and booster function. In the fully adjusted model, T1 was positively associated with larger LA minimum size (Beta: +0.034 SD per T1 SD; Confidence Interval (CI): 0.024, 0.045), and negatively associated with LA emptying volume (Beta: −0.017; CI: −0.027, −0.006), LA booster volume (Beta: −0.019; CI: −0.030, −0.008), LA emptying fraction (Beta: −0.052; CI: −0.062, −0.041), and LA reservoir function (Beta: −0.039, CI: −0.039, −0.017). Though adjustment for LV parameters did not fully attenuate the above relationships, LV parameters were consistent mediators between T1 and LA function, with proportional mediative effects ranging from 15% to 75%. Lastly, there is evidence of an inverted J-shaped relationship between T1 and LA function, with the associations becoming more apparent in the upper half of T1 ranges (turning points within 925–950 ms, median T1 = 930 ms) (p<0.05).

Conclusion: This study demonstrates a consistent association between higher native T1 values (as a marker of myocardial fibrosis) and lower LA global and phasic functions. We also highlighted an interplay between T1 values, LV remodelling and LA dysfunction. These findings will facilitate our understanding of the disease processes underlying cardiac dysfunction and myocardial remodelling at an early, subclinical stage.