

Computed Tomography-Derived Myocardial Left-Ventricular Wall Thickness and Extracellular Volume Fraction Quantification

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Aims: The aim of this study is to investigate the relationship between left ventricular wall thickness (LVWT) and myocardial extracellular volume (ECV) fraction computed from cardiac CT for the non-invasive assessment of potential LV arrhythmogenic substrate. Additionally, the CT metal artifacts caused by implantable cardioverter devices (ICD) leads in the quantification of ECV is investigated as a necessary comment on the correlation between ECV and LVWT.

Methods: A late-enhancement pre-procedural CT protocol was carried out at St Thomas' Hospital, London, for 9 VT ablation patients. Highly personalised 3D models constructed from a diastolic phase CT scan were used to quantify left-ventricular WT (LVWT), and a pre-, post-contrast, and angiography CT were used to compute the ECV fraction based on the difference in attenuation values. The paired measurements were then separated into basal, mi-ventricular, and apical regions, based on the 17 American Heart Association (AHA) segments, then grouped into "thin" and "healthy" myocardium at a threshold of 10 mm LVWT. A second division was made between the septal and all others segments to gauge the effect of the metal artefact caused by the right ventricle lead of the ICD.

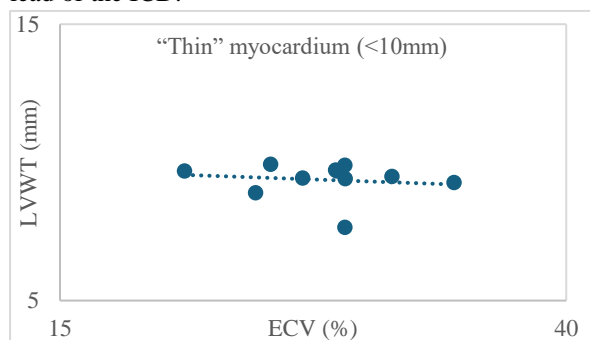


Figure 1: Scatter plot of ECV and LVWT values (blue dots) representing "thinning" AHA segments of <10mm, and their respective trendline

Conclusion: These preliminary findings further motivate the detailed investigation of the LV arrhythmic substrate in regions identified by low LVWT and high ECV. The correlation between CT-derived ECV and LVWT as indicators of fibrosis in these regions of interest, as well as the investigation of metal artifact reduction or elimination techniques for the quantification of ECV remain aspects of future work.

Results: Analysis of the ECV and LVWT results showed a minimal negative Pearson's correlation between the "thin" regions ($r = -0.14$, $p = 0.68$, Fig. 1). The mean ECV value of the septal segments ($31.30 \pm 1.26\%$) was higher than the mean measurements in all other segments ($27.59 \pm 2.71\%$), with no significant change in the LVWT (Fig. 2).

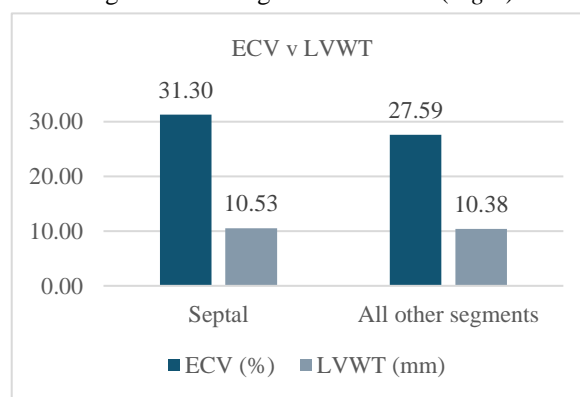


Figure 2: Bar chart of mean ECV and mean LVWT values in the AHA septal segments compared to all other segments