

Title: Cardiac CT-derived Extracellular Volume as an Alternative to Cardiac MRI for Myocardial Tissue Characterisation

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Background: Extracellular Volume (ECV) is a promising indicator of myocardial structural remodelling. Cardiac magnetic resonance (CMR)-derived ECV's utility has been validated histologically and clinically, however is often contraindicated in patients with implanted metal devices, renal dysfunction or claustrophobia. Cardiac computed tomography (CCT)-derived ECV offers a cheaper, less time-consuming alternative with fewer contraindications, but a direct comparison is required to evaluate its efficacy.

Objective: To develop a registration and artefact removal workflow and evaluate CCT-derived ECV against CMR-derived ECV for myocardial tissue characterisation.

Methods: Patients undergoing ventricular tachycardia ablation with pre-procedural CCT and CMR imaging were included. Pre- and post-gadolinium T1 maps were segmented to obtain CMR-ECV across a left ventricular (LV) myocardial slice. For CCT-ECV, pre-contrast and late iodine enhanced scans were registered to a CT angiography, automatically segmented for LV ECV quantification. Image Position Patient (IPP) and Image Orientation Patient (IOP) DICOM tags of the T1 maps were used to create a slice plane intersecting the CT LV volume (Figure 1a), registered to an MR volume by centre of mass. Separate artefact removal strategies were developed for implantable cardioverter defibrillator (ICD)-related artefacts in both modalities. Circumferential universal ventricular coordinates were computed using septal insertion points as reference points to split both slices into 6 American Heart Association (AHA) segments for segmental ECV comparison (Figure 1b).

Results: Thirteen patients were included. A mean cosine similarity of 0.986 ± 0.013 indicated preservation of the pattern of segmental ECV values between modalities. Segmental ECV correlation was modest ($r=0.284$, $p=0.0118$) but improved significantly after artefact removal across all patients ($r=0.481$, $p<0.001$) and in those with ICD artefact specifically ($r=0.617$, $p<0.001$; Figure 1c).

Conclusion: CCT-derived ECV shows meaningful agreement with CMR-derived ECV in both spatial distribution and magnitude. Artefact removal achieved a significant improvement in inter-modality concordance, though further evaluation in larger cohorts is warranted.

