



Myocardial T1 and Extracellular Volume Fraction Measurement in Heart Failure with Preserved Ejection: Reproducibility at 3T and Comparison with Heart Failure with Reduced Ejection Fraction

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Background

Myocardial fibrosis is important in heart failure (HF) progression and adverse outcomes. We aimed to evaluate cardiovascular magnetic resonance (CMR) T1 and extracellular volume (ECV) fraction mapping for quantification of the degree and extent of diffuse myocardial fibrosis in the left (LV) and right ventricles (RV) in HF patients with preserved ejection fraction (HFPEF) versus reduced ejection fraction (HFREF).

Methods

Study design:

- Prospective study (substudy of ATTRaCT);
- 34 HF subjects (15 HFPEF and 19 HFREF);
- CMR scanner 3.0T (Philips Ingenia);
- Medis Suite software: **Pre-** and **post-**contrast T1 mapping analysis were performed at the LV **mid-cavity** and **basal** short-axis levels with optimized MOLLI imaging parameters.
- Multiple regions-of-interest (ROIs):
 - 1) Entire myocardium in the slice (whole slice)
 - 2) Focal lesion areas corresponding to late-gadolinium enhancement (LGE)
 - 3) Remote healthy tissues at the septum
 - 4) LV lateral wall
 - 5) RV free wall.

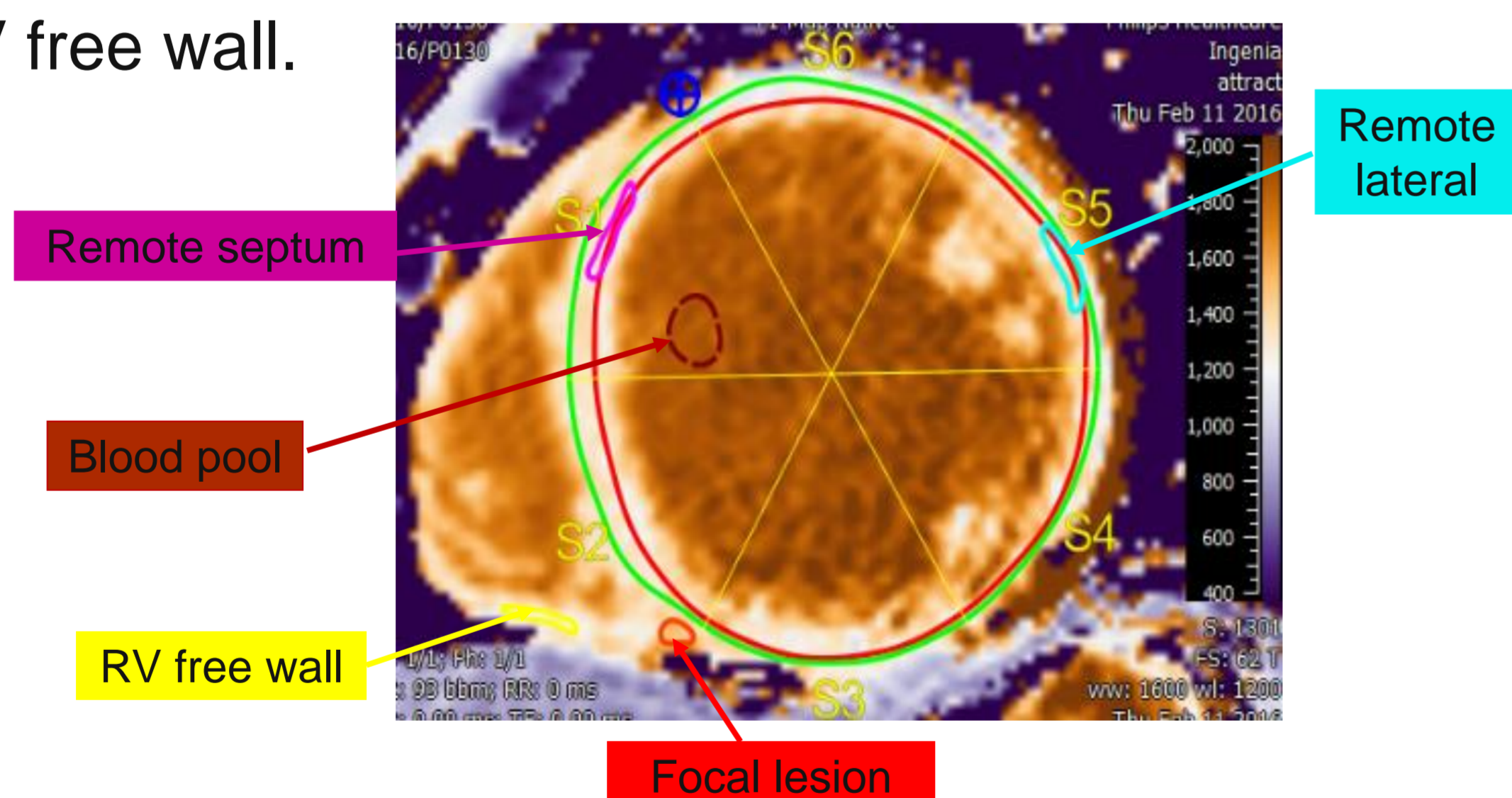


Figure 1. ROIs of T1 mapping analysis with Medis Suite software

- For quantitative analysis, pre- and post- T1 time, partition coefficient (λ) and extracellular volume (ECV) were analyzed.

$$\lambda = \frac{\left(\frac{1}{T1_{myo\ post}} - \frac{1}{T1_{myo\ pre}}\right)}{\left(\frac{1}{T1_{blood\ post}} - \frac{1}{T1_{blood\ pre}}\right)} \quad ECV = (1 - hematocrit)\lambda$$

- Intra- and inter- rater reproducibility were assessed in 10 randomly chosen subjects.

Results

- All the HF cases were further stratified into those with and without focal lesions on LGE, respectively.

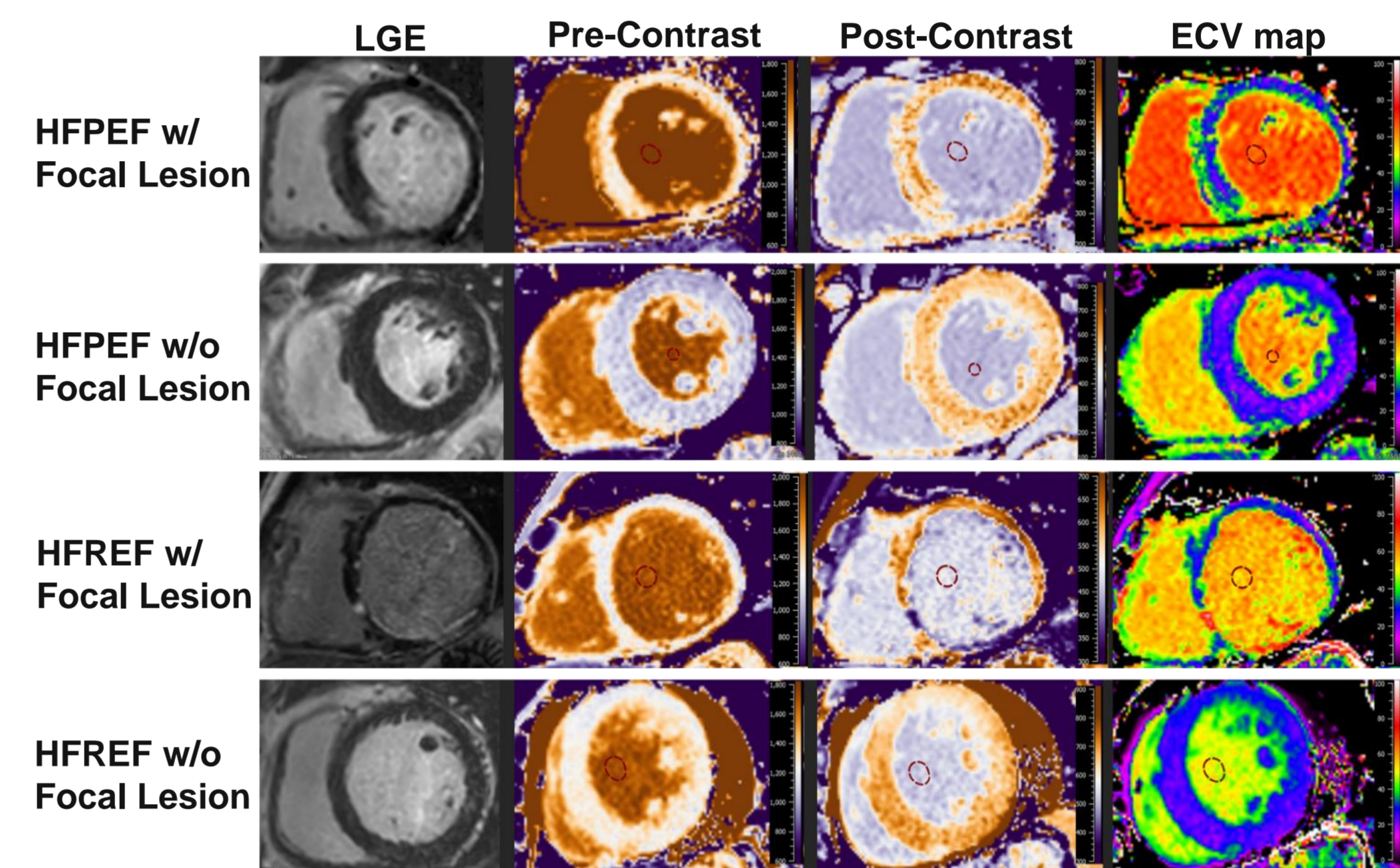


Figure 2. Typical result of pre-, post-contrast T1 and ECV maps with corresponding late-gadolinium enhancement (LGE) images in HF patients from four subgroups, respectively

- Excellent reproducibility with **intra-**($r = 0.9978$) and **inter-rater** ($r = 0.9794$).

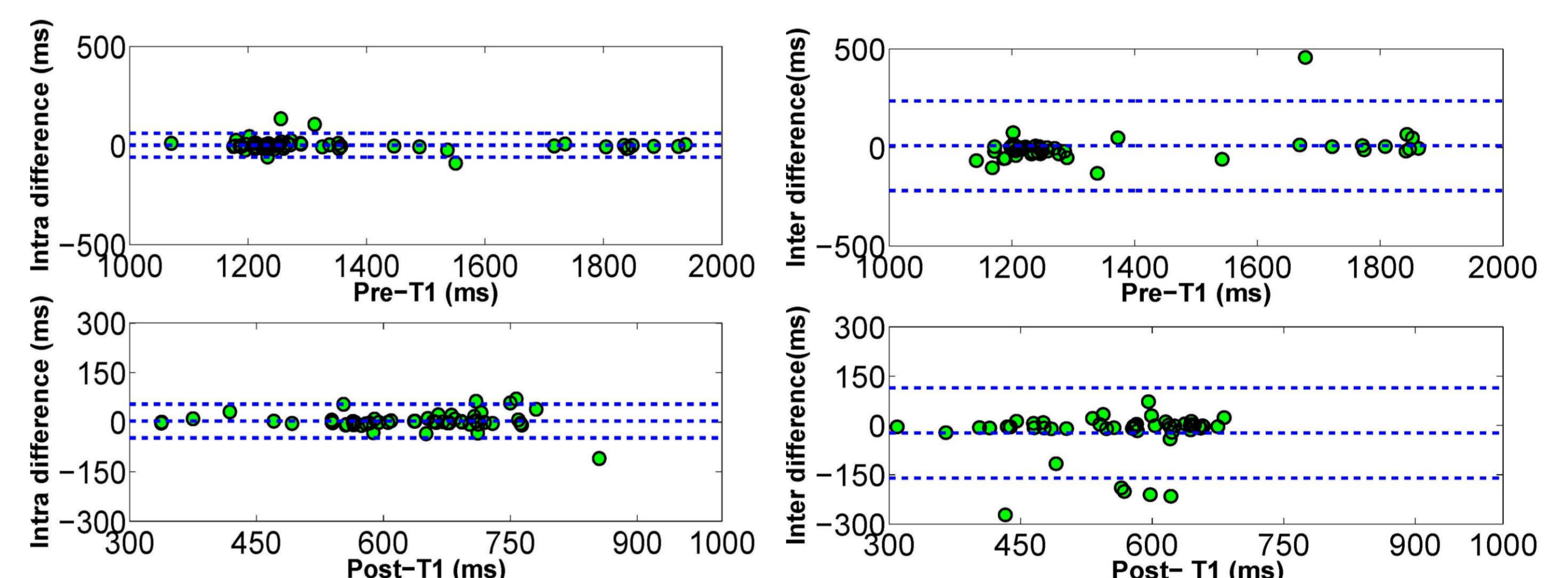


Figure 3. Bland-Altman bias plots of pre- and post- T1 time

- λ was significantly lower in HFPEF without focal lesion versus the other three subgroups.
- Across the groups, HFPEF with focal lesions had the highest value of λ and ECV including remote myocardium.

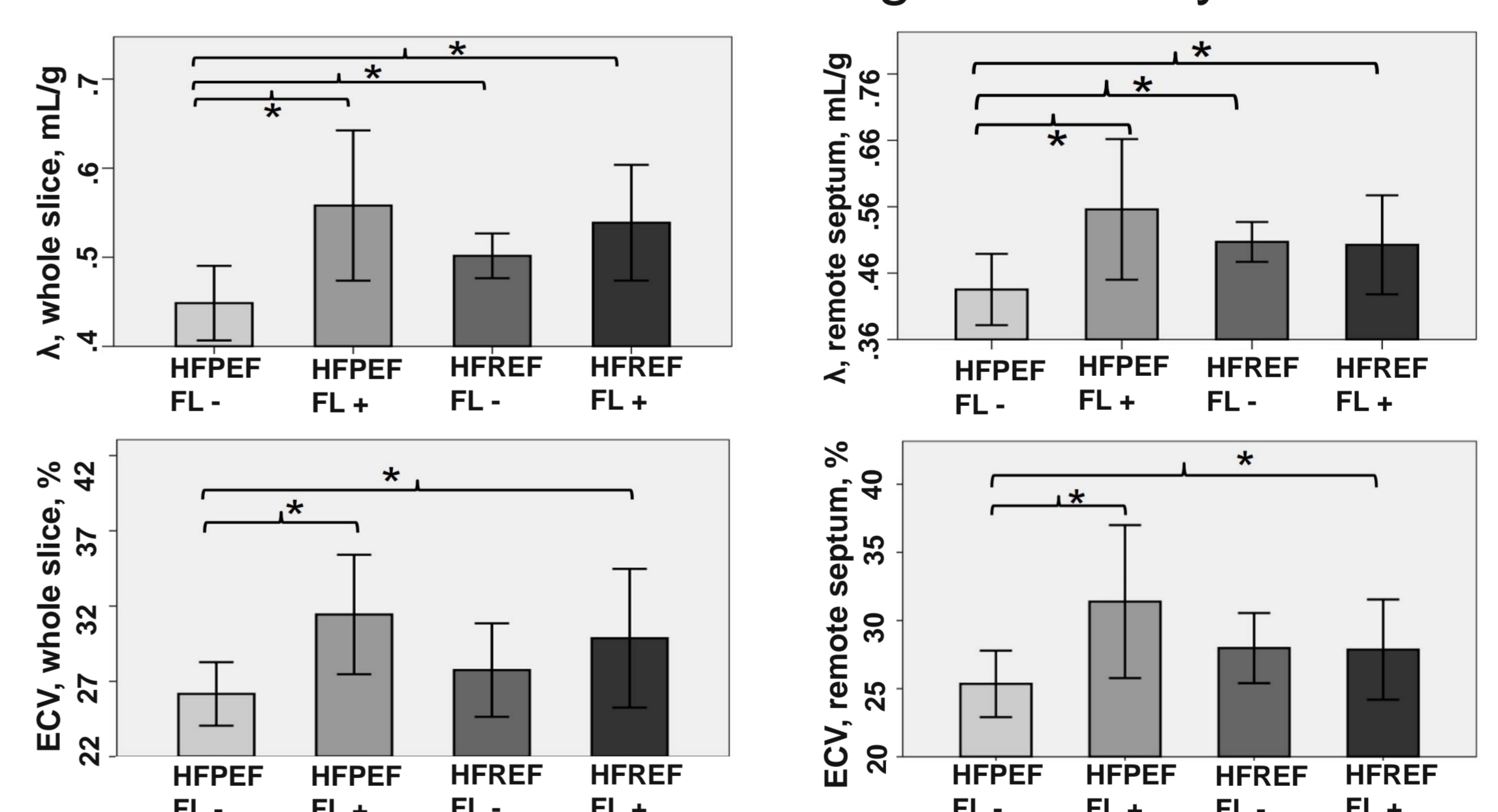


Figure 4. Comparison of parameters λ and ECV for all HF patients (FL= focal lesion)

Conclusion

Myocardial T1 and ECV mapping are simple and robust techniques that can be applied in patients with HF and distinguish between HFPEF and HFREF.

Acknowledgement

We would like to thank National Medical Research Council Foundation (NMRC) for supporting this study.

References:

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