POSTER PRESENTATION

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Quantification of the myocardial partition coefficient for intravenous iron (ferric carboxymaltose) using T1 mapping cardiovascular magnetic resonance

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Background

Cardiovascular magnetic resonance (CMR) T1 mapping has recently been shown to be highly sensitive for detecting myocardial iron overload. Furthermore, T1-mapping can be used to quantify relative concentrations of contrast agents that shorten T1. We hypothesized that T1 mapping can detect and quantify the myocardial distribution of a clinically available intravenous iron substitution agent.

Methods

CMR imaging was performed in healthy male volunteers ($n = 8$, mean $\pm$ SD age 27 ± 3 years). T1 of blood and myocardium was quantified using a modified Look-Locker inversion recovery (MOLLI) sequence for T1-mapping in a mid-ventricular short-axis slice at 1.5T (Siemens Aera). Images were acquired before and at regular intervals up to 50 minutes after onset of a 15 minute long injection of 20 ml (50 mg iron/ml) ferric carboxymaltose (Vifor Pharma). T1, R1 and $\Delta R1$ of myocardium and blood, and the partition coefficient (λ) for myocardium were measured over time.

Results

Both myocardial and blood T1 were shortened after intravenous injection of ferric carboxymaltose (Figure 1). Thus, there is an increase in both R1, which is the reciprocal of T1, and $\Delta R1$, which is the difference between post-contrast and pre-contrast R1, and is linearly related to contrast concentration. Notably, λ , which is the ratio

of $\Delta R1$ of myocardium to $\Delta R1$ of blood, remains constant over time (mean $\pm$ SEM, $61 \pm 6\%$ at 30 minutes).

Conclusions

T1 mapping can be used to detect and quantify the myocardial distribution of ferric carboxymaltose (figure 2). Furthermore, since λ remains unchanged over time, the concentration of ferric carboxymaltose in normal myocardium is in a dynamic equilibrium with the blood pool 20-50 minutes after intravenous injection. However λ in healthy myocardium for ferric carboxymaltose ($\sim 60\%$) was considerably higher than λ for gadolinium-based extracellular contrast agents from the literature ($\sim 40-45\%$)¹, thus indicating that ferric carboxymaltose distributes to a greater extent into the myocardium than extracellular agents, most likely by distribution also into the intracellular space. The described technique opens up the new possibility for using CMR to study *in vivo* myocardial iron physiology in health and disease.

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Figure 1 Mean values ($\pm$ SEM) for myocardial (black squares) and blood (white circles) T1, R1, Δ R1 and partition coefficient (lambda) over time after injection of ferric carboxymaltose in healthy volunteers (n = 8). R1 is equal to 1/T1. Δ R1 is the difference between post-contrast and pre-contrast R1 and is proportional to contrast concentration. Lambda is the ratio of Δ R1 of the myocardium to Δ R1 of the blood. Note that lambda is effectively unchanged between 20-50 minutes after injection.

Figure 2 (A) Pre-contrast (native T1) and (B) post-contrast (25 minutes after onset of ferric carboxymaltose injection) short-axis Modified Look-Locker Inversion recovery (MOLLI) sequence in a mid-ventricular slice. Note how T1 is visibly shorter following injection of ferric carboxymaltose compared to native T1