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The optimisation of cardiac iron overload assessment by systolic imaging

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Introduction

Without regular blood transfusions most patients with Thalassaemia major (TM) die during infancy. This however leads to tissue iron overload, in the heart potentially causing heart failure and subsequent death unless chelation therapy is instigated. The introduction of cardiovascular magnetic resonance (CMR) has been associated with a reduction in death rates from iron overload cardiomyopathy. Imaging allows identification of patients at risk of heart failure and regular follow-up aids the optimization of therapeutic regimes.

A bright blood gradient echo sequence with no delay after the R wave trigger has been validated for the assessment of cardiac iron levels. A full thickness septal ROI is selected for analysis, rate of signal intensity decay with increasing echo time is proportional to iron loading. Good image quality is usually obtained but there may be blood motion artifact, contrast between the myocardial and blood pool low and the septum thin in children and young adults. A black blood double inversion recovery (DIR) sequence has been developed with improved contrast and reduced blood signal contamination and improved reproducibility. The scan duration thus breath-hold is however considerably longer and it has only been possible to transfer this protocol to other Siemens scanners to date. At end systole myocardial thickness is maximal while blood volume is minimal which may improve image quality.

Purpose

To evaluate whether acquiring myocardial images during systole improves cardiac T2* evaluation in patients with iron overload.

Methods

22 consecutive TM patients were scanned using a 1.5 T Siemens Sonata scanner with a 6 channel phased array cardiac coil and ECG gating. A mid ventricular short axis slice was selected and imaged with no delay after the R wave trigger and at end systole, the trigger delay calculated from the corresponding cine image. The same slice was then imaged using the black blood preparation. A mono-exponential decay curve was derived for all acquisitions using Thalassaemia tools (CMRtools, Cardiovascular Imaging Solutions, London, UK) and expressed as T2*.

Results

The mean T2* was 11.3 ms (± 3.57) for black blood imaging, 12.3 (± 3.62) diastolic and 11.3 (± 3.57) for systolic bright blood imaging. There was no statistically significant difference between any groups.

Conclusion

This study suggests that imaging during systole can be utilized if septal visualization is inadequate in diastole and the DIR sequence breath-hold is too long. It may also be preferential in highly iron overloaded patients where the right ventricular septal boundary may be oured.