

Poster presentation

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## Cramer-Rao lower bounds for precision in T2\* assessment for myocardial iron overload measurements by T2\* multi-echo CMR

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### Introduction

T2\* multiecho CMR is an established methodology for assessment of iron overload in heart and other organs. It is commonly recognized that MR sequences used in the clinical practice provide the best precision in T2\* measurement in the range 3-20 ms, while an increasing error is expected out of this range. However, the dependence of the expected error from T2\* and acquisition parameters is unknown.

### Purpose

The objective of this study is to quantify the precision limit of T2\* assessment exploiting the Cramer-Rao lower bounds theory (CRLB).

### Methods

CRLB provide a fundamental limit to the accuracy in determination of the T2\* value from experimental data; for any estimation method, the error in the parameter (measured as the standard deviation or SD) must be greater than or equal to the CRLB. CRLB for T2\* estimation were evaluated taking into account the statistics (i.e. MR signal and noise) of MR images involved in the measurements obtained from image data acquired during the MIOT project. CRLB were evaluated for several echo times

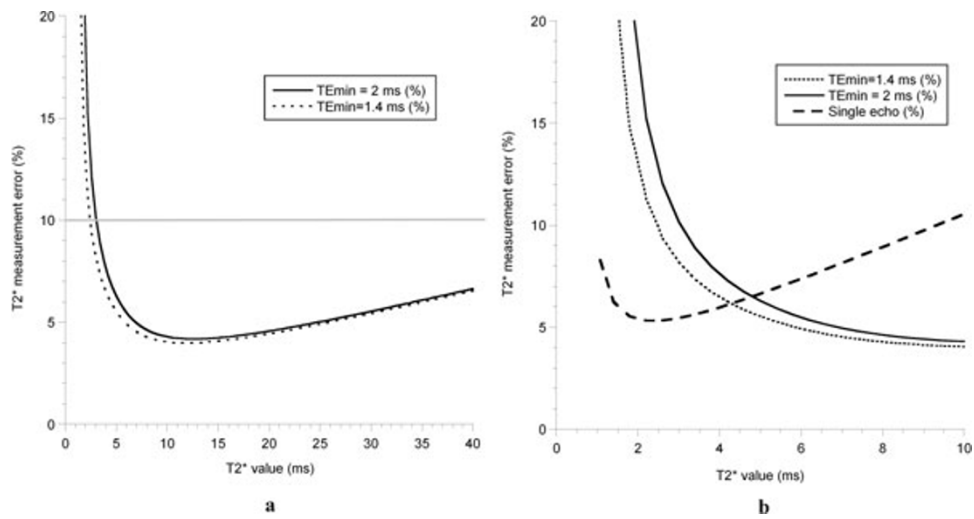
configuration used in the clinical setting on GE 1.5 T scanners for iron overload evaluation in thalassemia patients.

### Results

Figure 1.a shows CRLB for percent error in commonly used single breath-hold sequences with first echo time at 2 ms and 1.4 ms, echo spacing 2.26 ms, 10 echoes. Achievable measurement error is lower than 10% in the range 3-40 ms if minimum TE of 2 ms is used and lower than 10% in the range 2.5-40 ms for minimum TE of 1.4 ms. Only 3 patients (0.3%) had a global T2\* < 3 ms among the 1324 patients in the MIOT database. Figure 1.b shows CRLB for percent error for low T2\* values for the two single-breath-hold sequences previously described and a multi-breath-hold sequence with minimum echo time of 0.9 ms and echo interval 0.8 ms. Achievable precision is greatly improved for T2\* < 4 ms.

### Conclusion

GRE Multiecho sequences with minimum TE less than 2 ms assure good precision in T2\* assessment in heart for T2\* values less than 3 ms. This limit includes almost all thalassemia patient in a large population studied in Italy during the MIOT project. For patients with very high myocardial iron overload or for measurements in other organs



**Figure 1**  
**CRLB for T2\* assessment.**

with heavier iron overload (i.e. liver) sequences with lower minimum echo time and/or lower echoes interval may be useful.

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