

Dynamic contrast enhanced MRI of bone marrow in rheumatoid arthritis and the response to treatment.

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Introduction

Bone inflammation in rheumatoid arthritis has been shown to be linked to bone marrow oedema (BME) seen on MRI [1]. The presence of BME correlates with disease progression and is a good predictor of subsequent bone erosion [2,3]. It is conventionally assessed from the extent of BME seen on T2 weighted MR images but this can be difficult to quantify as the edges of the oedematous region are poorly defined; furthermore, only the extent and not the degree of inflammation is assessed. Dynamic contrast enhanced (DCE) MRI is a good measure of inflammation in synovitis and may also be useful in bone. A pilot study of 7 patients with BME looking at localized regions suggested DCE-MRI of bone marrow may be more sensitive than conventional measures of BME 2 weeks after starting treatment [4]. The aim of this prospective, larger study was to determine whether DCE-MRI measurements from entire bones can detect a long term response to treatment and to assess the reproducibility of these measures.

Method

30 patients with long-standing, active RA were studied. The wrist and metacarpophalangeal (MCP) joints of the dominant hand were imaged before and at 12 and 24 weeks after starting biologic therapy.

Imaging was performed at 1.5T with the wrist and MCP joints imaged simultaneously in an eight channel knee coil. 15 3D SPGR images were acquired, one every 19 seconds before (4 images), during and after the administration of intravenous contrast (0.1 mmol/kg Gd-DOTA, 1x1x0.8mm resolution, 200x100x56mm field of view, 35° flip-angle, 7.5ms TR and 4.8ms TE (in-phase)). T2 weighted fast spin echo (3000/57) and pre and post contrast 3D VIBE (30/7/30) images were also acquired.

Manually segmentation of an entire carpal bone was performed. Where BME was present, the most oedematous bone was chosen. Care was taken not to include any synovitis or erosions in the region selected. The same bone was segmented at subsequent visits. The relative early enhancement rate (RER), defined as the maximum change in signal intensity over 19s relative to pre-contrast images was derived from the segmented volume. Changes in the RER between baseline, 12 and 24 weeks were assessed for significance using the Wilcoxon matched-pairs signed rank test. 10 randomly selected datasets were segmented twice by the same reader and once by a second reader and the inter- and intra-reader intra-class correlation coefficients (ICCs) were calculated to assess reproducibility of segmentation.

Results

The RER showed a statistically significant reduction between both baseline and week 12 ($P = 0.017$), and baseline and week 24 ($P = 0.027$).

The intra-observer and inter-observer ICC's were 0.998 and 0.990 respectively.

Discussion

This study demonstrates that the RER calculated from DCE-MRI of bone marrow can detect a response to treatment. It shows that DCE-MRI of bone marrow may be useful for detecting a response 3-6 months after starting treatment, the time when response is traditionally assessed clinically. Measurements may be made from an entire bone, removing the need for expert, subjective assessment of the extent of BME. This may contribute to the good reproducibility of segmentation seen here. DCE-MRI of bone marrow may therefore provide a useful method for quantitatively assessing inflammatory change in the bone in RA.

Conclusion

In rheumatoid arthritis, DCE-MRI measurements taken from bone marrow of an entire carpal bone can detect changes in response to therapy.

References

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