Comparison of in-office magnetic resonance imaging versus conventional radiography in detecting changes in erosions after one year of infliximab therapy in patients with rheumatoid arthritis

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Abstract The objective of this study was to compare standard hand radiographs with in-office 0.2T magnetic resonance imaging (MRI) in monitoring response to therapy in patients with rheumatoid arthritis (RA) who were receiving infliximab, to evaluate the frequency and location of erosions, and to determine if there were differences in outcome based on disease duration at baseline. Patients who satisfied the American College of Rheumatology criteria for RA and were receiving infliximab therapy were evaluated with a baseline and 1-year follow-up MRI. Magnetic resonance images were interpreted by two blinded, board-certified radiologists. Bone erosions were identified as well-defined defects extending through the cortical margin. The mean age of the 48 patients was 58.5 years. The median infliximab dosage was 4 mg/kg. Baseline data showed that 41 patients had abnormal MRIs. The mean time between the baseline and follow-up MRI examinations was 10.5 months. Follow-up MRI revealed regression in 11 patients. Thirty-one patients had both MRIs and radiographs. Magnetic resonance imaging was approximately twice as sensitive as radiography in detecting erosions at baseline. In-office MRI was useful in monitoring disease response after the initiation of infliximab treatment. Magnetic resonance imaging is potentially a very valuable diagnostic tool and prognostic indicator for use in patients with RA.

Key words Erosion · Infliximab · Magnetic resonance imaging · Radiography · Rheumatoid arthritis

Introduction

Rheumatoid arthritis (RA) is a chronic disease leading to progressive joint damage and functional decline. Seventy-five percent of joint damage occurs within the first 5 years of onset of disease and continues throughout the course of the disease. Consequently, diagnosis and treatment of early RA is crucial in slowing disease progression and preventing the disability associated with it.

The newest class of disease modifying antirheumatic drugs (DMARDs) target tumor necrosis factor alpha (TNFα). Infliximab, an anti-TNFα monoclonal antibody, has proven to be highly effective in the treatment of RA patients. The United States Food and Drug Administration approved dosage of infliximab is 3 mg/kg at 0, 2, 6 weeks and then every 8 weeks thereafter. Infliximab should be given in combination with methotrexate. Monotherapy with infliximab is not indicated for the treatment of RA. There are currently no company-sponsored infliximab monotherapy trials for RA; however, monotherapy for other indications is being evaluated. For patients who had an incomplete response, the infliximab dosing may be adjusted up to 10 mg/kg or treating as often as every 4 weeks. Treatment with infliximab plus methotrexate has provided clinical benefit while inhibiting the progression of radiographic damage and preserving joint integrity in patients with active RA. Nevertheless, it can sometimes be very difficult to determine the absolute benefit of this expensive form of therapy for individual patients.

Routine hand radiographs of patients with RA have been used to assess disease at baseline and to monitor disease progression after the initiation of therapy. Studies have shown that magnetic resonance imaging (MRI) may be more sensitive than standard radiographs in detecting bone erosions and the change in bone erosions in response to therapy in early RA. Thus, MRI can be beneficial in helping to determine the absolute benefit of therapy for individual patients.

The present study was undertaken in order to compare the value of standard hand radiographs versus in-office...
MRI evaluations in monitoring the response to therapy in patients with RA who were receiving infliximab. A second objective was to evaluate the frequency and location of erosions. A third objective was to use an in-office MRI system to evaluate changes in baseline and follow-up erosive status in patients with RA who were treated with infliximab to determine if there were differences in outcome based on disease duration at baseline.

Materials and methods

Study design and patients

In this retrospective chart review of a single rheumatology practice in the United States, patients who satisfied the American College of Rheumatology criteria for the diagnosis of RA \(^1\) were evaluated at baseline and after approximately 1 year of therapy with infliximab. All patients had two MRI studies and some patients received both MRI and radiographic evaluations of disease progression. Baseline for each patient was defined as the time of the first MRI. After the initial titration, all patients received infusions of infliximab every 7 weeks for the duration of the study. Patients were also treated with methotrexate, nonsteroidal anti-inflammatory drugs, and steroids as necessary. The in-office MRI system in this study (MagneVu 1000, Carlsbad, CA, USA, self-shield low-field [0.2 Tesla scanner]) operates on standard 110-V power and occupies minimal office space.

Assessments

Magnetic resonance and X-ray images were interpreted independently by two board-certified radiologists experienced in musculoskeletal imaging (S.N., D.R.) who were blinded to patients’ clinical status, but not to the chronology of the examinations. Both radiologists read each image, and disagreements were resolved by consensus. Coronal 3D T1W (TR/TE = 100/24 ms) and 3D STIR (TR/TE/TI = 100/24/50 ms) sequences were acquired with the following imaging parameters: 1-cm-thick slab of 10 images at 1 mm thickness and no gap; field of view 4.9 × 7.5 cm; matrix 128 × 85; 2 acquisitions; echo train length = 4; series acquisition time = 8 min. Due to the small fixed field of view, examinations were targeted to visualize the second and third metacarpophalangeal (MCP) joints and to include as many of the carpal bones as possible. Between 85% and 100% of the target anatomy could routinely be imaged using these parameters. In one patient, the second and third metatarsophalangeal (MTP) joints were assessed.

Radiographs of the hand and wrist were performed in anterior/posterior, oblique, and lateral projections. All carpal bones and MCP joints were included.

Bone erosions were identified as well-defined marginal defects with cortical extension. The MRI signal characteristics for erosions were low signal intensity with respect to marrow fat on T1-weighted images and high signal intensity on short tau inversion (STIR) images. Erosions were classified as small (<15% metacarpal head involvement), moderate (between 15% and 50% metacarpal head involvement), or large (≥50% metacarpal head involvement). “Regression” was defined as a significant (greater than 20%) change in size of erosion in at least one plane or a conspicuous change in T1 signal, and “stability” was defined as no significant (less than 20%) change in size of erosion or of its signal characteristics. The functional status of the patient at the 1-year follow-up assessment was rated independently by the physician and patient as improved, no change, or worse.

Results

Demographics

The charts of 48 patients, who were treated with i.v. infliximab during 2003 or 2004, were retrospectively reviewed. The mean (±SD) age of the patients was 58.5 ± 17.1 years (range, 16–86 years), and 18 patients were older than 65 years of age. The duration of RA was <1 year in 13 patients, <2 years in 7 patients, 3–5 years in 9 patients, and >5 years in 19 patients. Thirty-one of the 48 patients received both MRI and radiography and were included in evaluating the first objective, MRI versus standard radiography in monitoring the response to therapy with infliximab.

The median infliximab dosage was 4 mg/kg (range, 3–6 mg/kg). At the time of the first MRI, 43 patients were receiving combination therapy with infliximab and methotrexate (median dosage, 15 mg; range, 10–20 mg) and 40 patients were also receiving prednisone (median dosage, 10 mg; range, 1–20 mg). At the time of the second MRI, these numbers had decreased to 24 patients for both methotrexate and prednisone. At the time of the first MRI, 5 patients were receiving monotherapy with infliximab and this number increased to 13 patients at the time of the second MRI.

Magnetic resonance imaging results

A total of 83 baseline examinations were performed on the 48 patients. One patient had MRI imaging of bilateral second and third MTP joints. Thirty-four out of the remaining 47 patients had bilateral evaluations of the carpal bones and second and third MCP joints. Thirteen patients had a unilateral MRI exam at baseline.

Baseline MRI showed the following results: (1) of the 83 studies, 64 were abnormal in 41 patients; (2) 7 patients had no MRI abnormalities; (3) 45 examinations out of the 83 were positive for MCP erosions in 34 patients; (4) 36 out of 83 studies were positive for carpal bone erosions in 24 patients; and (5) 1 patient showed erosion in an MTP joint. The mean time between the baseline and follow-up MRI examinations was 10.5 ± 4.1 months (median, 11 months; range, 5–19 months). Follow-up MRI showed regression of 9 MCP joint erosions, 8 carpal bone erosions, and 1 MTP...