Concise Report

Bone erosions at the distal ulna detected by ultrasonography are associated with structural damage assessed by conventional radiography and MRI: a study of patients with recent onset rheumatoid arthritis

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Objectives. Ultrasonography (US) is a sensitive tool for detecting erosions in patients with RA. The wrist is usually involved in the RA process, where the distal ulna with its superficial localization is easily accessible for US examination. In this longitudinal study, we wanted to examine the presence, localization and development of erosions at the distal ulna by US in patients with recent onset RA, and to analyse whether erosions at this localization are associated with joint damage in hands assessed by conventional radiography (CR) and MRI.

Methods. Seventy patients with recent onset RA (median disease duration 106 days) were examined by US of the distal ulna, in addition to hand radiography [assessed by van der Heijde-modified Sharp score (vdHSS)] and MRI of the wrist [assessed by RA MRI scoring (RAMRIS) erosion score]. Twelve months later 58 patients were re-assessed.

Results. US detected erosions at the distal ulna in 11% of the patients at baseline and 24% at follow-up (the majority of erosions were at the ulnar side). Logistic regression analyses showed the presence of erosions at baseline to be associated with baseline RAMRIS erosion score (P < 0.001), and at follow-up to RAMRIS erosion score (P = 0.02) and vdHSS (P = 0.008).

Conclusions. A significant number of patients had US erosions at the distal ulna at baseline, with increased prevalence after 1 year. The US-detected erosions were associated with structural joint damage in hands assessed by both MRI and CR. US of the distal ulna could thus give useful clinical information.

Key words: Ultrasonography, Early rheumatoid arthritis, Erosions, Distal ulna, MRI, Radiography.

Introduction

The presence of bone erosions in patients with early RA indicates a severe disease course. Ultrasonography (US) is an imaging technique that is able to detect erosions [1] with a higher sensitivity and specificity than conventional radiography (CR) [2, 3]. The sensitivity and specificity are comparable with MRI for joint surfaces assessable by US [2–4], and high interobserver agreement on US erosions has been found [3, 5]. In addition, the US-detected erosions have been shown to be true erosions when CT was used as the reference method [6].

The wrist joint is commonly affected in RA. In a longitudinal study of wrist involvement in RA patients, radiographic erosions of the styloid ulna were seen as a relatively early isolated finding in 25% of the patients [7]. Further, the distal radioulnar joint showed a rapid increase of erosions and was involved in 78% of the patients with established disease [7]. The distal ulna may be examined by US to assess erosions in the superficial part of the bone. Erosions on the dorsal part may be caused by inflammation of the radioulnar joint, with synovitis extending over the dorsal area of the distal ulna, whereas erosions at the ulnar side may be caused by tenosynovitis of the extensor carpi ulnaris (ECU) tendon.

The two main objectives of the present study were to assess, in patients with recent onset RA, the presence, size and location of erosions at the distal ulna by the use of US, and to examine whether US erosions were associated with overall joint damage in hands assessed by CR or wrist MRI.

From a cohort of 84 patients with recent onset RA [8], 70 patients (53 (76%) women, median [interquartile range (IQR)] disease duration 106 (62–184) days, age 58 (48–66) years) were eligible for participation in the present study, which focused on US examination of the distal ulna in the dominant hand. A total of 53 patients (76%) used DMARDs including MTX (n = 43), anti-TNF drugs (n = 1) and prednisolone (n = 43). Fifty-eight patients were available for follow-up and were re-assessed after 12 months (not including the patient using anti-TNF medication).

All US examinations were performed by H.B.H. with the use of an 8–12-MHz linear array transducer on a Diasus machine (Dynamic Imaging Ltd, Livingston, UK) that did not have Doppler function. The patients were sitting with their dominant hand resting on a small table. The diameter of the largest US erosion on the dorsal as well as the ulnar part of the distal ulna (Fig. 1) was measured in two perpendicular planes and graded as follows: no erosion, 0; erosions with diameter ≤2 mm, 1; with 2–4 mm, 2; and >4 mm, 3.

Bilateral digital CR of hands and wrists in the postero-anterior view was scored by a trained observer (P.B.) for erosions and joint space narrowing according to the van der Heijde-modified Sharp score (vdHSS) with a possible maximum score of 280 U [9, 10]. MRI of the dominant wrist was performed using a 1.5-T scanner with a dedicated high-resolution wrist phased array coil. The images were scored by E.A.H. according to the semiquantitative RA MRI scoring (RAMRIS) erosion score [11, 12] with a maximum score of 10 for each assessed joint: 0, no erosion; 1, 1–10% of the bone eroded; 2, 11–20%; etc., and with a possible maximum total erosion score of 150 U.

Clinical examinations included visual analogue scale (VAS) pain, VAS patient global assessment of disease activity, modified health assessment questionnaire (MHAQ) (range 0–3) and VAS health.
assessor’s evaluation of disease activity. ESR was performed as part of the laboratory routine tests, and serum was frozen at −70°C for later analysis of CRP (high-sensitive nephelometry), anticyclic citrullinated peptide (anti-CCP) (second-generation ELISA with levels from 1 to 251 U/ml, cut-off at 25) as well as IgA and IgM rheumatoid factor (RF) (‘in-house’ ELISA, range of 2–300 U/ml, cut-off at 25). The local ethics committee [The Regional Committee for Medical and Health Research Ethics (REK), Southeast] approved the study, and the patients signed informed consent according to the Declaration of Helsinki.

Statistical methods

The variables were not normally distributed and therefore non-parametric tests were used. Group comparisons were performed by using Mann–Whitney U-test, and binary logistic regression analyses were applied to investigate for associations. A P-value <0.05 was considered as statistically significant.

Results

Erosions at the distal ulna were detected by US in 8 of the 70 patients (11.4%) at baseline (Grade 1, n = 5; Grade 2, n = 3). At follow-up, 14 (24%) of the 58 patients had US erosions (Grade 1, n = 9; Grade 2, n = 3; Grade 3, n = 2). Eleven patients with no US erosions at baseline developed erosions after 1 year (Grade 1, n = 9; Grade 2, n = 2). Two patients had an increase in erosion size from Grade 1 to 3, and one patient had an unchanged Grade 2 erosion. At baseline, the erosion at the distal ulna having the largest diameter was found at the ulnar side in five patients and at the dorsal side in three patients. At follow-up, the corresponding numbers of patients were 12 and 2.

MRI of the distal ulna showed erosions in 49 (71%) of the 69 patients at baseline (Score 1, n = 47; Score 2, n = 1; Score 3, n = 1), and in 46 (74.2%) of the 62 patients at 12 months examination (Score 1, n = 39; Score 2, n = 6; Score 3, n = 1), including one new patient with erosion. Except for one, all patients with erosions detected by US had erosions assessed by MRI both at baseline and follow-up.

CR of the distal ulna showed erosion in only 2 (2.8%) of the 69 patients at baseline. Two (3.2%) out of 63 patients had erosions at the 12-month follow-up, including one patient who had developed erosion on CR during the study. Of the 8 patients with US-detected erosions at baseline, only 1 patient had radiographic erosion, and of the 14 patients with erosion on US at follow-up, only 2 had erosion seen on radiography.

The median (IQR) vdhSS levels at baseline/follow-up was 2 (0–5)/3 (1–8) and the RAMRIS erosions levels were 8 (5–11)/9 (6–13), respectively. At baseline/follow-up, the median (IQR) of the laboratory and clinical assessments were as follows: CRP, 5 (2–10)/4 (2–7) mg/l; ESR, 15 (10–22)/12 (7–17) mm/h; anti-CCP, 41 (4–251)/37 (3–244) U/ml; IgA RF, 11 (1–39)/6 (1–27) U/ml; IgM RF, 14 (3–92)/10 (1–54) U/ml; VAS pain, 20 (9–37)/22 (9–41) mm; VAS patient global assessment of disease activity, 23 (10–38)/22 (12–44) mm; VAS assessor’s evaluation of disease activity, 11 (9–18)/9 (6–15) mm; and MHAQ 0.1 (0–0.6)/0.1 (0–0.5).

Patients with US erosions at baseline had higher RAMRIS erosion scores as well as higher levels of CRP, anti-CCP and IgA RF than non-erosive patients (Table 1). The two patients with US erosion scores increasing from Grade 1 to 3 during the study had baseline RAMRIS erosion scores of 28 and 29 vs median (IQR) 8 (5–11) in the other patients (P = 0.001). The 11 patients developing US erosions during the study had significantly higher baseline levels of VAS pain (P = 0.03), VAS patient global assessment of disease activity (P = 0.03), VAS assessor’s evaluation of disease activity (P = 0.002) and MHAQ (P = 0.03) as well as follow-up total vdhSS score (P = 0.05) than patients not developing erosions. However, neither baseline vdhSS nor RAMRIS erosion levels were significantly different between the groups. The patients developing erosions were all on anti-rheumatic medication (MTX, n = 7; low-dose prednisolone, n = 4).

Logistic regression analyses with the presence of US erosions at baseline as the dependent variable showed significant associations with baseline RAMRIS erosion score (P < 0.001) when adjusted for sex, age and disease duration. Similar analyses with the presence of US erosions at follow-up as the dependent variable and follow-up RAMRIS erosion score or vdhSS values in the equation (adjusted for sex, age and disease duration) showed significant associations with both RAMRIS and vdhSS (P = 0.02 and 0.008, respectively).

Discussion

Imaging techniques such as US and MRI have increased the sensitivity for detecting erosions in early RA [13–15]. Most US studies have been performed on MCP or MTP joints, since these joints are frequently affected in RA patients and are simple to examine by US. However, the distal ulna is also easily accessible for US examinations, and the radioulnar joint and the ECU tendon sheath are both frequently inflamed in RA patients. The present study is, to our knowledge, the first to assess US erosions of the distal ulna in RA patients with very short disease duration. US erosions were found in about one-tenth of the patients at baseline, with a significant increase after 1 year. Erosions detected by US were also seen on MRI, but only in one and two patients on CR at baseline and follow-up, respectively.

The presence of US erosions at the distal ulna was found to be associated with joint damage assessed by CR and MRI of hand joints. A limitation of the present study was focus on erosions only, without assessing the synovitis surrounding the distal ulna. However, the present finding indicates that this simple US assessment may be useful in the evaluation of disease severity in early RA patients. Another potential limitation is that US is operator dependent. However, all assessments were performed by a single experienced assessor (H.B.H.). A reliability study should ideally
have been performed. As a proxy for reliability assessments, 59 of the patients were reassessed 3 months after baseline examinations. Seven of these patients had erosions both at baseline and after 3 months, no patient had US-detected erosions at baseline not seen at the 3-month assessment, whereas six new patients had developed erosions.

Most of the US erosions were found at the ulnar side of the distal ulna, which is located under the ECU tendon. Thus, inflammation in the tendon sheath may cause bone erosions. MRI studies have shown that tenosynovitis in the ECU tendon is a frequent finding [16, 17]. US erosions were also found at the dorsal part of the distal ulna, and these erosions were located under the ulnar area of the synovitis extending from the radio-ulnar joint. Future study should assess both the radioulnar joint and the ECU tendon by the use of greyscale and power/colour Doppler US, to explore the possible associations between active inflammation and development of erosions.

Even though the patients received standard medical treatment, several developed US erosions of the distal ulna during the 1-year follow-up, and these patients had a more active disease. There are few prospective studies of US-detected erosions, but the present finding supports previous US studies that showed increased number of erosions in finger joints after 2 or 7 years [18, 19].

The presence of US erosions at the distal ulna was, in this study, associated with increased structural joint damage in hand joints assessed by radiography and MRI. This is a small study, and larger studies should be performed to explore the current topic further. However, the present study suggests that US of the distal ulna, which is an easily performed examination, could be performed on patients with early RA, and the presence of erosions would indicate a more severe disease course.

### Rheumatology key messages

- A significant number of patients with early RA have US erosions at the distal ulna.
- Presence of US erosions was associated with structural joint damage in hands assessed by CR and MRI.

**Disclosure statement:** The authors have declared no conflicts of interest.

**References**


