

Clinical Study

The relationship between an intramedullary high signal intensity and the clinical outcome in atlanto-axial subluxation owing to rheumatoid arthritis

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Abstract

BACKGROUND CONTEXT: In patients affected by cervical spondylotic myelopathy (CSM), numerous authors have reported the existence of a relationship among the intramedullary high signal intensity in T2-weighted MRIs, preoperative neurologic severity, and neurologic recovery after surgery; however, to our knowledge, there have been no previous reports that have described its relationship in patients with atlanto-axial subluxation (AAS) owing to rheumatoid arthritis (RA).

PURPOSE: The purpose of this study was to clarify the characteristics of patients with AAS owing to RA showing intramedullary high signal intensity in T2-weighted MRIs, and to assess the relationship with the neurologic severity and neurologic recovery after surgery.

STUDY DESIGN: This was a retrospective cohort study.

PATIENTS SAMPLE: Fifty consecutive patients (37 females and 13 males) with AAS treated by surgery were reviewed.

OUTCOME MEASURES: The outcome was determined 1 year after surgery.

METHODS: According to preoperative T2-weighted MRIs, the patients were classified into two groups as follows: An NC group not showing any signal intensity change on sagittal images, and an SI group showing signal intensity changes with narrowing of the spinal cord. In all patients, we investigated the atlanto-dental distance (ADD) and the space available for the spinal cord (SAC) at the neutral position and the maximal flexion position in lateral cervical radiographs before surgery. We also observed MRIs 1 year after surgery in the SI group. We evaluated the severity of neurologic symptoms before and 1 year after surgery in all patients.

RESULTS: Preoperative T2-weighted MRIs demonstrated NC in 38 cases and SI in 12 cases. The preoperative average ADD at the neutral position in the NC and SI groups was 6.4 and 10.2 mm, respectively ($p < .01$). The preoperative ADD at the maximal flexion position in the two groups were 10.8 and 13.8 mm, respectively ($p < .01$). The preoperative average SAC at the neutral position in the NC and SI groups were 17.6 and 13.8 mm, respectively ($p < .01$). The SAC at the maximal flexion position in the two groups were 14.3 and 10.8 mm, respectively ($p < .01$). The SI group included significantly more Ranawat grade III cases showing severe neurologic deficits compared to the NC group ($p < .01$). However, there were no differences between the two groups regarding the number of patients with Ranawat grade III status after surgery ($p > .65$). On MRIs 1 year after surgery, the regression or disappearance of the signal intensity change in T2-weighted images was demonstrated in four and seven cases, respectively.

CONCLUSIONS: Preoperative ISHI in T2-weighted MRIs in RA-induced AAS patients was demonstrated in patients showing an enlargement of the ADD and a narrowing of the SAC. This affected the preoperative neurologic severity, but not the postoperative severity, which was in contrast to CSM patients. Furthermore, the regression or disappearance of ISHI was demonstrated in all

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of the cases after surgery. It is therefore speculated that RA AAS patients may have both dynamic instability and stenosis. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Atlanto-axial subluxation; Intramedullary high intensity change; Rheumatoid arthritis; Clinical outcome

Introduction

It is widely accepted that rheumatoid arthritis (RA) affects not only the joints of the extremities but also the cervical spine. Paus et al. [1] assessed the mortality rate in a cohort of surgically treated and nonsurgical patients and noted that RA with neck involvement is a progressive and serious condition with a reduced life expectancy. We have noted that there are three common features of subluxation in RA patients: Atlanto-axial subluxation (AAS), vertical subluxation, and subaxial subluxation. Nguyen et al. [2] noted that atlanto-axial instability is the most common, and represents 65% of all cervical subluxations. Sunahara et al. [3] noted that, in the patients receiving conservative treatment with myelopathy owing to AAS, the calculated survival rate was 0% in the first 7 years after the onset of myelopathy. Furthermore, Matsunaga et al. [4] noted that all of the irreducible AAS patients who did not undergo surgical treatment were bedridden within 3 years after the onset of myelopathy, and the survival rate was 0% in the first 8 years. Casey et al. [5] noted the strong likelihood of surgical complications, the poor survival and the limited prospects for functional recovery in nonambulatory patients, thus making a strong case for earlier operative intervention.

Magnetic resonance image has been used not only to depict how the spinal cord is compressed anatomically but also to reflect the pathologic changes within the spinal cord by following the changes in signal intensity in patients with cervical lesions. In patients affected by cervical spondylotic myelopathy (CSM), numerous authors have reported a relationship to exist among intramedullary high signal intensity in T2-weighted MRIs, the preoperative neurologic severity and the neurologic recovery after surgery; however, to our knowledge, there have been no previous reports describing this relationship in patients with AAS owing to RA. Therefore, the purpose of this study was to clarify the characteristics of patients with AAS owing to RA showing intramedullary high signal intensity in T2-weighted MRIs, and to determine its relationship with the neurologic severity and neurologic recovery after surgery.

Materials and methods

Fifty consecutive patients with AAS treated by surgery at our university hospital between 2001 and 2011 were reviewed. The patients consisted of 37 females and 13 males. The duration of RA ranged from 3 to 49 years, with a mean duration of 15.3 years. The average patient age at surgery was 60.2 years (range, 29–78). Atlanto-axial subluxation was diagnosed by a lateral cervical radiograph showing an anterior atlanto-dental interval on a flexion radiograph of 3

mm or more. In patients with cervical myelopathy with atlanto-axial instability, surgery was usually indicated. In addition, when patients complained of only neck pain after unsuccessful adequate conservative treatment, they were also recommended to undergo surgery. Selective atlanto-axial arthrodesis (transarticular screw fixation) [6,7] was performed for all patients, and none required more extensive surgery, such as occipito-cervical fusion. The research protocol for this study was approved by our institutional review board.

Radiographic studies

In all patients, we investigated the atlanto-dental distance (ADD) and space available for the spinal cord (SAC) at the neutral position and maximal flexion position in lateral cervical radiographs before surgery (Fig. 1).

MRI studies

All patients underwent preoperative MRI. According to preoperative T2-weighted MR imaging, the patients were classified into two groups as follows: An NC group not showing any signal intensity change on sagittal images, and an SI group showing signal intensity changes with narrowing of the spinal cord on the same image. We also observed MRIs 1 year after surgery in the SI group. Two authors reviewed the MRIs from all patients and determined whether or not any signal intensity changes existed in the spinal cord. One of evaluators did not perform these surgeries and was blinded to the patients' clinical data.

Three kinds of MRI systems were used in this study: A 1.5-T (Signa, GE Medical Systems, Little Chalfont, UK), 1.5-T (MAGNETOM Symphony, Siemens, Munich, Germany), and a 3.0-T system (Trio MAGNETOM, Siemens). The T2-weighted images of sagittal views of the spinal cord were obtained using a fast spin echo sequence system for all systems. A surface coil was used. The slice width was 3 mm. In the 1.5-T Signa system, the sequence parameters were a repetition time (TR) of 3500 milliseconds and an echo time (TE) of 102 milliseconds. For the 1.5-T MAGNETOM Symphony, the sequence parameters were TR 3800 milliseconds and TE 91 milliseconds. For the MAGNETOM Trio, the sequence parameters were TR 4000 milliseconds and TE 89 milliseconds.

Severity of neurologic symptoms

We evaluated the severity of neurologic symptoms before and 1 year after surgery. Any neurologic impairment and the clinical severity of the disease were assessed by

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