Prognostic application of magnetic resonance imaging in patients with endometriomas treated with gonadotrophin-releasing hormone analogue

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We evaluated the usefulness of magnetic resonance imaging (MRI) for assessing the response of patients with endometriomas to medical therapy. MRI was performed before and after treatment in 20 consecutive patients with at least one endometrioma with a maximal diameter >10 mm diagnosed by laparoscopy who received 900 μg of buserelin acetate daily for 6 months. Patients were categorized as good responders (group I, n = 13) and poor responders (group II, n = 7) depending on the results of a third-look laparoscopy performed 6 months after treatment. We determined the ratio of the signal intensity (SI) of the endometrioma to the SI of the gluteus maximus muscle on T2-weighted images [T2SI/M (muscle) SI] and the volume of the endometrioma. The volume decreased by >50% in 61.5% of the good-response group and 57.1% of the poor-response group. There was no significant difference between the two groups. The T2SI/MSI decreased in 12 of 13 patients in group I but in only one of seven patients in group II, a significant difference (P < 0.05) between the two groups. In the good-response group, there was a positive linear correlation between the decrease in the volume of the endometrioma and the decrease in the T2SI/MSI after treatment (r = 0.561, P < 0.05). Therefore, the T2SI/MSI determined from MR images may be useful in assessing the therapeutic response of patients with endometriomas.

Key words: endometrioma/magnetic resonance imaging/medical treatment/signal intensity

Introduction

A recent advance in the medical treatment of endometriosis is the use of gonadotrophin-releasing hormone analogues (GnRHa). Acute reductions in the 1985 revised American Fertility Society (AFS) classification score have been noted by many authors (Lemay et al., 1984; Schriock et al., 1985; Steingold et al., 1987). Steingold et al. (1987) showed a reduction in the size of endometriomas in all five women studied. However, recurrence is a major problem in treating endometriosis, unless definitive surgery is performed. Most clinicians monitor the efficacy of medical therapy on the basis of the patient’s symptoms and the physical examination. Barbieri and Hornstein (1987) reported that a decrease in pelvic pain, resolution of uterosacral ligament nodularity, and a decrease in cul-de-sac induration were strongly related to laparoscopically documented improvements in endometriosis. Although laparoscopy remains the best method for evaluation of the effect of therapy, it is invasive and expensive, and thus cannot be performed repeatedly. Several reports have shown that magnetic resonance imaging (MRI) is useful for diagnosis of endometriosis (Arrive et al., 1989; Zawin et al., 1989; Togashi et al., 1991; Takahashi et al., 1994). Sugimura et al. (1992) investigated the clinical application of MRI for the staging of endometriomas by measuring relaxation times and found that the T1 value appeared to be useful for assessing the progression of endometrial cyst. We have previously found that the T2 signal intensity reflects the iron concentration of endometriomas, suggesting that it may be useful for estimating their fluid characteristics (Takahashi et al., 1995).

In the present study, we assessed the usefulness of MRI for estimating the response of patients with endometriomas to medical treatment.

Materials and methods

MR images were obtained before and after treatment in 20 Japanese women with endometriosis, aged 21–37 years (mean, 28 years). Endometriosis was diagnosed by laparoscopy and staged according to the 1985 revised AFS classification. Of the 20 patients, nine had stage III, and 11 had stage IV. All patients had at least one endometrioma >10 mm in maximal diameter. Two patients had one cyst only, 10 had two cysts, five had three cysts, and three had four cysts. The patients received 900 μg/day of buserelin acetate (Suprecur: Hoechst, Tokyo, Japan) for 6 months.

Patients were divided into two groups depending on the presence or absence of symptoms and the results of a third-look laparoscopy performed 6 months after discontinuation of treatment. Group I included 13 patients classified as having a good response because they had no symptoms and their persistent endometriosis score (AFS, 1985) determined at the third-look laparoscopy was lower than that at the second-look laparoscopy, which was performed immediately after completion of treatment. Group II included seven patients with a clinical recurrence associated with pelvic pain and an increase in the endometriosis score at the third-look laparoscopy (poor response).

Surgery was performed within 2 weeks of MRI and before the patient's next menstrual period. MRI was performed with a 1.5-T superconducting unit (Signa; GE Medical Systems, Milwaukee, WI) using a spin-echo (SE), multisection imaging technique that has been previously described (Takahashi et al., 1994). T1-weighted [SE 600/15 ms (repetition time/echo time)], proton-density (2,200/15 ms), T2-weighted (2,200/80 ms) and fat-saturated T1-weighted (600/15 ms) axial images were obtained in all patients. Data acquisition was...
performed twice; the field of view was 32 × 32 cm, and the thickness of the slice was 6 mm with a 2 mm interslice gap. A 256 × 256 matrix was used for the T1-weighted and fat-saturated T1-weighted images. A 256 × 192 matrix was used in T2-weighted imaging. Inferior and superior saturation pulses were applied.

We measured the largest endometrioma in each patient. Calculated T2 images were obtained from the T2-weighted image and the proton-density image. We designated a region of interest on the T2-weighted images that covered as much as possible of the endometrioma. A region of interest exceeding 100 pixels was drawn over the gluteus maximus. We designated the same region of interest in the endometrioma on the calculated images. We measured the signal intensity (SI) on conventional images and the T2-value on calculated images three times and determined the mean value. We obtained the calculated T2-value and the signal intensity on T2-weighted images (T2SI) of each endometrioma. To normalize the T2SI among subjects, we calculated the ratio of the SI of the endometrioma to the SI of the gluteus maximus on T2-weighted images (T2SI/MSI).

Fat-saturated T1-weighted imaging (Takahashi et al., 1994) was used to measure the volume of the endometrioma. The area of the endometrioma on each image was measured using a microcomputer with a digitizer (NEC PC-8001 mKII: NEC, Tokyo, Japan). The volume of the column was calculated by the following formula: volume = A × (D1 + D2), where A, D1, and D2 are the area, the slice thickness (6 mm), and the interslice gap (2 mm) respectively. The volume of the endometrioma was calculated by adding the volumes of the columns on all images obtained.

The MR images were read prospectively by two of the authors (I.L., K.S.) who were aware only of the patient's initial diagnosis. They recorded the location, the size and the appearance of the lesions (i.e., the homogeneity and the SI of the lesion compared with the adjacent adipose tissue and striated muscle). The observers attempted to reach a consensus after careful assessment of serial images. MR images obtained before and after treatment were read separately and blindly. Data were analysed by Wilcoxon's matched-pair signed-rank test or the Kolmogorov–Smirnov two-sample test. The relationship between analysed parameters was assessed by the linear regression method. A P value <0.05 was accepted as the level of statistical significance.

Results

The pretreatment revised AFS score ranged from 16 to 148 points in group I and from 24 to 150 points in group II. The mean ± SD of the pretreatment revised AFS score was 66.7 ± 51.5 in group I and 94.6 ± 50.3 in group II. There was no significant difference between the two groups. The post-treatment revised AFS score was significantly (P < 0.05) lower after treatment in both groups (group I: mean 55.6 ± 43.8 points, range 6–145 points; group II: mean 75.7 ± 56.1 points, range 12–146 points), but there was no significant difference between the two groups.

The maximal cyst volume measured before treatment was 76.4 ml. The minimal cyst volume was 1.1 ml. The volume of the endometrioma decreased following treatment in all patients, except one (1.6% increase of volume) in group II. The cyst volume ranged from 3.4 to 96.2%. The volume decreased by >50% in eight (61.5%) of 13 patients with a good response and four (37.1%) of seven patients with a poor response. There was no significant difference between the two groups in the percentage decrease in volume. Table I shows the median value and the ranges of volume of the endometriomas before and after treatment. In both cases, there was no significant difference between the two groups. After treatment, the mean volumes of the endometriomas in both groups were significantly lower (P < 0.05) than the pretreatment values.

The T2SI/MSI decreased following treatment in 12 (92.3%) of 13 patients in group I but in group II T2SI/MSI decreased in one patient (1/7) and showed no change in one patient (1/7). There was a significant difference (P < 0.05) between the two groups in this respect. Table II shows the median value and the ranges of the T2SI/MSI before and after treatment. Before treatment, no significant difference in the T2SI/MSI was observed between the two groups. The T2SI/
MSI was lower in group I than in group II after treatment, but the difference was not significant. There was no significant difference in the T2SI/MSI before and after treatment in group II. In group I, however, the T2SI/MSI was significantly lower after treatment than before treatment.

The endometrial volume and the T2SI/MSI were not correlated in group II but there was a positive linear correlation (r = 0.561, P < 0.05) between the decrease in endometrial volume and the decrease in the T2SI/MSI after treatment in group I (Figure 1).

Discussion

An endometrioma is caused by repeated episodes of haemorrhaging and is thus a retention cyst. The cystic fluid may contain varying amounts of haemoglobin. The fluid content can also change as the cyst progresses. In the present study, we investigated whether changes in the content of endometriomas were associated with the stage of the endometrioma. Previous studies have shown that the concentrations of methaemoglobin and free Fe$^{3+}$ ions in intracranial haematomas are related to the T2-value, while the haematocrit is related to the T1-value (Bradley and Schmidt, 1985; Stark et al., 1985). The T1-value and the concentration of iron in the endometrioma are negatively correlated, and the T1-value is useful for distinguishing fresh endometriomas from old endometriomas (Sugimura et al., 1992). We (Takahashi et al., 1995) previously found that the T2SI/MSI decreased in association with increases in the concentration of iron, indicating that the iron concentration is indirectly related to the SI on T2-weighted images in endometriomas. Because the protein concentration of a fluid is known to influence its SI (Stark et al., 1985), the iron concentration we measured (Takahashi et al., 1995) may have reflected the protein concentration.

The present results showed that the T2SI/MSI of endometriomas decreased in patients with a good response to GnRHa therapy. This decrease may have been related to the treatment-induced reduction in the volume of endometrial tissue responsible for bleeding. However, the T2SI/MSI of endometriomas tended to increase (not significantly) in patients with a poor response following treatment, although the decrease in the volume of endometriomas was similar in patients with poor and good responses. The apparent increase in the T2SI/MSI may have been related to the failure of treatment to reduce endometrial tissues. Despite treatment, new bleeding may be produced during the reduction and/or absorption of the fluid content of the cysts. The present results suggest that the magnitude of the decrease in T2SI/MSI after treatment is related to the prognosis of patients with endometriomas. Our findings suggest that the SI on MRI may be helpful in assessing the response of patients with endometriomas to medical treatment. Although sensitivity and specificity of MRI should be known for the purpose of prognostic application of MRI in diagnosing patients with endometrioma, it was very difficult to calculate them in the present study because of the limitations of the low number of patients studied. Therefore, the final outcome must be evaluated further in a prospective study including a large series of patients with endometriosis.

References


Received on December 4, 1995; accepted on March 6, 1996