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Avascular Necrosis of the Femoral Head with Diffuse Bone Marrow Edema Pattern on MR imaging: A Case Report

Soichiro Hirata and Hitoshi Ishikawa

Avascular necrosis of the femoral head (AVN) is a disease that often results in the destruction of the hip joint. The early finding of magnetic resonance (MR) imaging of AVN is characterized by a focal lesion demarcated by a low-signal-intensity line on T1-weighted images. We report on a 63-year-old woman with unilateral AVN which initially demonstrated only osteopenia of the head on radiographs and diffuse edema pattern in the head extending to the intertrochanteric region on MR images. These findings were indistinguishable from those of transient osteoporosis of the hip. Six months later, it developed to collapse of the head and showed a focal lesion typical of AVN on MR images. We emphasize that AVN should be considered as a differential diagnosis when MR images exhibit diffuse edema pattern of bone marrow.

Key Words
Avascular necrosis of the femoral head, Transient osteoporosis, Magnetic resonance imaging, Bone marrow edema.

INTRODUCTION

Avascular necrosis of the femoral head (AVN) is not an uncommon disease, which commonly affects individuals in the third to fifth decade of life (1). The treatment is largely dependent on a stage when the diagnosis is made in the course of the disease. Core decompression with or without bone grafting may have potential to prevent the subsequent collapse of the femoral head if done in early stages (2-4). In contrast, patients with degenerative changes in advanced stages often require hemiarthroplasty or total joint replacement even though they are young and active. The application of these arthroplasties have generally resulted in early failure in these cases (5,6). For these reasons, early diagnosis of AVN is a key for successful treatment. However, in early stages it demonstrates very subtle or no radiographical signs, making diagnosis difficult. The use of magnetic resonance (MR) imaging has been the most accurate approach to detect the lesion in early stages when radiographically negative (7-11). The characteristic and early findings of MR imaging are a focal lesion lined by a low-signal-intensity band or a ring on T1-weighted images or double lines on T2-weighted images. These lines or bands are considered to represent a reparative interface between necrotic and viable bone in response to osteonecrosis (7,8,11,12). We report on a 63-year-old woman with unilateral AVN of which MR images
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in an early stage demonstrated atypical presentation of diffuse bone marrow edema indistinguishable from transient osteoporosis of the hip (13-18). Also, distinction between these two conditions is discussed.

CASE REPORT

A sixty-three-year-old woman with a five-year history of chronic liver dysfunction caused by hepatitis C virus had a dull ache in acute and abrupt onset in the left groin since the end of August 1994. She visited us on 7th September. She was obese, 144 cm and 67 kg, and had an antalgic limp. The left hip joint had a slightly limited range of motion and was tender. She did not have any history of trauma in the hip joint, administration of corticosteroids or excessive ingestion of alcohol. A roentgenograph of the left hip joint showed osteopenia in the femoral head compared to the right (Fig. 1a, b). There was no apparent deformity of the head. White blood cell count and a concentration of C-reactive protein were within normal limits. MR images (Vectra 2, Yokogawa Medical, 0.5 Tesla) were taken on 14th in the same month. T1-weighted images revealed a diffuse low-signal-intensity lesion in the head extending to the intertrochanteric area (Fig. 1c). T2-weighted images depicted high-signal-intensity in the same lesion and presence of joint fluid (Fig. 1d). These findings of MR imaging indicated edema of the bone marrow. Culture of the aspirated joint fluid for bacteria was sterile. She was hospitalized for non-weight-bearing to obtain a pain relief. One-month hospitalization decreased the pain. She was allowed to discharge and return to a normal level of activity.

On 2nd in March 1995, 6 months after the onset of symptom, she visited again complaining of increasing pain in the left hip. The head was found to collapse segmentally on an antero-posterior roentgenogram (Fig. 2a). It was more evident in lateral view (Fig. 2b). The degree of collapse was estimated within 2 mm. T1-weighted images clearly depicted a focal lesion with a low-signal-intensity line (Fig. 2c). T2-weighted images also showed a corresponding focal lesion (Fig. 2d). The edema lesion and joint fluid were still present. These radiographs and MR images confirmed the diagnosis of AVN. She did not agree to an arthroplasty since the pain gradually subsided with analgesics and limited activity. She is now followed carefully.

DISCUSSION

Recent development in MR imaging enables making diagnosis of AVN in early stages. Although there is a conflicting data (19), it has been generally accepted that MR imaging is more sensitive and specific than plain radiography, computed tomography and radionuclide bone imaging (7-11). Reports on early findings of MR images of AVN have been concentrated on a focal lesion within the head. There have been a few reports in the literature on AVN exhibiting unusual diffuse edema pattern in the bone marrow (8, 20-22). Mitchell et al. found these marrow changes in 2 (4%) of 56 hips with AVN (8). Turner et al. described 5 cases (6
AVN with diffuse edema pattern on MR imaging

Figure 1. Images of a 63-year-old woman with pain in the left hip joint.
(a) A plain antero-posterior roentgenograph of the right hip.
(b) A plain antero-posterior roentgenograph of the left hip. Note osteopenia of the femoral head compared to a. There was no apparent deformity of the left head.
(c) Coronal T1-weighted MR image (TR/TE, 400/13, 0.5 Tesla). A diffuse marrow lesion with low-signal-intensity relative to normal marrow in the left femoral head extending to the intertrochanteric area (arrowhead).
(d) T2-weighted image (TR/TE, 2000/100) in the same plane as c. Corresponding lesion with high-signal-intensity (arrowhead), indicating edema in the bone marrow. Joint effusion was also present (arrow).

hips). In 3 of them, the diffuse pattern changed to a characteristic focal lesion of AVN in 6 weeks to 4 months, as observed in the present case. Since the marrow edema has been thought to be an early event in the course of the disease (2) and can be seen in other conditions such as transient osteoporosis (13-18), osteomyelitis (23), and occult fracture (24), they speculated that the diffuse change of edema reflects a nonspecific response of bone marrow following a severe insult to the head.

Because the present case had no history of trauma and the blood examination did not indicate infection, transient osteoporosis of the hip should be considered as a differential diagnosis. AVN and transient osteoporosis are very different in terms of prognosis. As the term transient in-
Figure 2. Images taken 6 months after Figure 1.
(a) A plain antero-posterior roentgenograph of the left hip. Segmental collapse of the head (arrowhead).
(b) A plain lateral roentgenograph. Collapse was more evident but within 2mm (arrowhead).
(c) Coronal T1-weighted images (TR/TE, 620/25). Note a focal lesion with a low-intensity-band (arrowhead) characteristic of avascular necrosis in the left head. A diffuse low-intensity lesion (arrow) was remaining with some resolution compared to Fig. 1c.
(d) T2-weighted images (TR/TE, 1800/90) in the same plane as c. Note a focal lesion (arrowhead) and a diffuse lesion (arrow) with high-intensity.

dicates, the latter is self-limited and resolves spontaneously (13-18). It is important to differentiate the two conditions for the optimal therapeutic management. Some authors postulated that transient osteoporosis is a special and reversible form of AVN with the same etiology of vascular occlusion (25,26). Hence, MR images of diffuse edema pattern particularly in early stages do not seem to give sufficient information. There is only one report that high-spatial-resolution T2 weighted images and contrast-enhanced images were helpful to distinguish the two conditions (22). This case initially presented two clues to lead to the diagnosis of AVN. The first, she had a history of a chronic liver disease, one of predisposing factors of AVN. The second is that the interval between the onset of symptom and the initial roentgenograph of the left hip demonstrating osteopenia was about 10 days, that is too short to manifest this change in case of transient osteoporosis. Four to eight weeks are usually required
(18). We emphasize that MR images of diffuse edema changes in the bone marrow may indicate early stages of AVN and that careful examination, taking detailed clinical history, and radiologic follow-up are essential to make an accurate diagnosis.

REFERENCES