A clinicopathologic study of transient osteoporosis of the hip

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Abstract  Objective. It has been proposed that transient osteoporosis of the hip (TOH) may represent the early reversible phase of osteonecrosis of the femoral head (ON). The purpose of this study was to investigate the clinicopathologic characteristics of three cases of TOH.

Design and patients. A bone biopsy was performed on three patients who had been diagnosed as having TOH based on the clinical course, radiograph, bone scintigram, and MR images. The biopsy specimens were studied histopathologically by light and electron microscopy.

Results. The most characteristic feature of TOH was focal areas of thin and disconnected bone trabeculae covered by osteoid seams and active osteoblasts. The surrounding bone marrow tissue showed edematous changes and mild fibrosis, frequently associated with vascular congestion and/or interstitial hemorrhage. No osteonecrotic region was observed in either the bone trabeculae or the bone marrow tissue. All patients have improved clinically and in the 3.5–9 years of follow-up have shown no evidence of ON.

Conclusions. This study supports the concept that transient osteoporosis of the hip is a distinct entity.

Key words  Transient osteoporosis of the hip · Osteonecrosis · Osteopenia · Bone marrow edema · Femoral head

Introduction

Transient osteoporosis of the hip (TOH) is a rare disease seen in pregnant women and middle-aged men. It is characterized clinically by severe pain without an obvious antecedent cause. The radiologic characteristics of the affected femoral head are focal loss of radiodensity, a diffuse homogeneous uptake on bone scintigraphy, and on MR imaging a bone marrow edema pattern of diffuse decreased signal on T1-weighted images and increased signal on T2-weighted or STIR images [1–4]. Since first being reported by Curtiss and Kincaid in 1959 [1], TOH has generally been considered as a self-limiting disease with spontaneous resolution of the symptoms after 6–12 months.

Recent confusion with regard to the diagnosis of TOH has resulted from the report by Turner et al. [5], who described five patients with hip pain who initially showed a bone marrow edema pattern on MR imaging and were shown histologically to have either bone and marrow necrosis or to progress subsequently to focal changes reported to be highly specific for osteonecrosis of the femoral head (ON). This concept that TOH may represent an early reversible phase of ON has recently received further support [6–8].

Although it is possible for these two conditions to be mistaken for each other using either clinical or radiologic criteria, it is nevertheless important to distinguish between them, since TOH is a self-limiting disease while ON is usually progressive and may eventually require operative treatment. This study investigated the clinicopathologic features seen in TOH.
Materials and methods

Diagnosis and patients

The medical records, radiographs, bone scintigrams, and MR images in four hips from three patients with a definite diagnosis of TOH were reviewed. The diagnosis was based on the following criteria: a focal loss of radiodensity in the femoral head on the plain radiograph, hip pain for 2–6 months, slight limitation of motion with pain, negative laboratory findings, and a high uptake on 99mTc bone scintigraphy [1, 4]. We also required the MR imaging finding of a bone marrow edema pattern with a diffuse area of low intensity on T1-weighted images and high intensity on T2-weighted or STIR images [2, 3]. Patients with transient bone marrow edema syndrome, who showed no focal loss of radiodensity on the plain radiograph [2, 9], were not included. Follow-up radiographs and/or MR images were obtained in all cases. None of the three patients had risk factors for ON, such as corticosteroid intake, alcohol abuse, or any underlying disease.

MR imaging was performed using a 1.5-T superconducting magnet (SMT150X, Shimadzu, Kyoto, Japan). T1-weighted (repetition time (TR), 500 ms; echo time (TE), 20 ms) and STIR (TR, 3000 ms; TE, 22 ms) images were obtained in the coronal and axial planes using a spin echo technique. The slice thickness was 5 mm.

Bone biopsy and tissue preparation

A bone biopsy was performed in three hips from three patients using a trephine 5 or 8 mm in diameter. Each biopsy specimen was taken exactly through the abnormal area using intraoperative X-ray control. In all cases, the biopsy track on the postoperative radiographs and/or MR imaging designated that each bone cylinder had been obtained from the affected region.

Tissue samples were fixed with 10% formalin–0.1 M phosphate buffer, pH 7.4. The samples were decalcified with 25% formic acid and then neutralized with a sodium sulfate buffer. The specimens were embedded in paraffin, cut into 4 µm sections, and then routinely stained with hematoxylin and eosin. Yoshiki’s staining was used to visualize osteoid seams in decalcified tissue [10]. The sections were obtained from the center of the lesion to avoid the artifact of the bone biopsy.

For the electron microscopic examination several bone fragments were obtained from the affected portion and immersed in 3% glutaraldehyde in 0.1 M cacodylate buffer, pH 7.4, at 4°C for 4 h. After washing in cacodylate buffer, they were postfixed in 1% chilled osmium tetroxide buffered with 0.1 M cacodylate solution, pH 7.4, dehydrated in a graded ethanol series, and then embedded in Epon 812. Ultrathin sections were stained with both uranium acetate and lead citrate, and examined using a JEM 100C (Tachikawa, Japan).

These histopathologic examinations were performed independently by two of the authors who have a primary interest in orthopedic pathology.

Results

Clinical outcome

In all cases, all abnormal changes on the radiographs, bone scintigrams, and MR images returned to normal within 1 year after the onset of hip pain. The 3.5–9 years of follow-up have found no evidence of ON.

Case 1 (bilateral involvement)

A 33-year-old woman in the last trimester of pregnancy suffered from left hip pain for 2 months. The affected femoral head showed a loss of radiodensity in the superolateral portion with a normal joint space on the radiograph (Fig. 1A), and a corresponding high uptake on the bone scintigram with some increase in uptake in the rest of the femoral head and the femoral neck as compared with the opposite side (Fig. 1B). MR imaging showed a diffuse area of low signal intensity on T1-weighted images in the upper outer quadrant of the femoral head and the lower femoral neck (Fig. 1C) and diffuse high signal intensity on STIR images in the same area but additionally in the femoral head and neck. Joint effusion was also observed (arrows). E. Radiograph 8 months after the onset of pain shows a normal appearance. The focal radiolucent area seen in A is improved. F,G MR images 8 months after the onset of pain. Both the T1-weighted SE image and the STIR image show a normal appearance. The very low intensity band on the T1-weighted image has disappeared.

Case 2

A 40-year-old man suffered from severe right hip pain. The affected femoral head showed a diffuse loss of radiodensity with a normal joint space on the radiograph, and a high uptake on the bone scintigram. MR imaging showed a diffuse area of low signal intensity on T1-