

Subchondral insufficiency fracture of the femoral head after liver transplantation

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Abstract A 53-year-old woman developed a subchondral insufficiency fracture of the right femoral head after undergoing a liver transplantation. Radiographs obtained at her first visit demonstrated a slight subchondral collapse in the superolateral portion of the femoral head. Magnetic resonance imaging (MRI) disclosed an irregular, discontinuous, low-intensity band on the T1-weighted image. After 7 months of conservative treatment, the hip pain and the radiograph abnormalities had both disappeared. On the follow-up T1-weighted MR image obtained 17 months after the onset, the band of low signal intensity was not obvious. A subchondral insufficiency fracture is one of the diagnoses to be considered in patients presenting with hip pain after a liver transplantation.

Keywords Subchondral insufficiency fracture · Magnetic resonance imaging (MRI) · Liver transplantation

Introduction

Subchondral insufficiency fracture of the femoral head (SIF) was first reported in 1996 [1]. SIF occurs mainly in elderly osteoporotic patients and in renal transplant recipients [1–4]. Regarding patients after liver transplantation, Guichelaar et al. described 360 consecutive patients who

were assessed for the presence of both vertebral and nonvertebral (rib, pelvic and femur) fractures [5]. Recently, one case of subchondral insufficiency fracture of the femoral head after liver transplantation was reported by Gerot et al. [6].

We recently treated a patient who had a subchondral insufficiency fracture of the femoral head after undergoing liver transplantation. We herein report the patient's detailed clinical course and discuss the possible mechanism of the fracture.

Case report

A 53-year-old woman reported the sudden onset of right hip pain, with no history of any antecedent trauma. She was unable to walk. Seven weeks before the onset of the hip pain, she had undergone liver transplantation due to a diagnosis of primary biliary cirrhosis. The steroid dosage used at the time of transplantation was 2,500 mg prednisolone per day. Mycophenolate mofetil and cyclosporine were also used for immunosuppressive treatment (Fig. 1).

The patient's height was 148 cm, and her weight was 52 kg. Her body mass index indicated a normal body type (23.7 kg/m²). The range of motion in her right hip was 120° flexion, -5° extension, 20° abduction, 10° adduction, 30° external rotation and 15° internal rotation.

Two weeks after the onset of the right hip pain, radiographs revealed a slight subchondral collapse in the superolateral portion of the femoral head (Fig. 2). Her bone mineral density (BMD), measured by dual X-ray absorptiometry, was 0.788 g/cm² (T score -0.7, which was within the normal range) at the total hip area in the right, while it was 0.763 g/cm² (T score -0.9) at the total hip area in the left.

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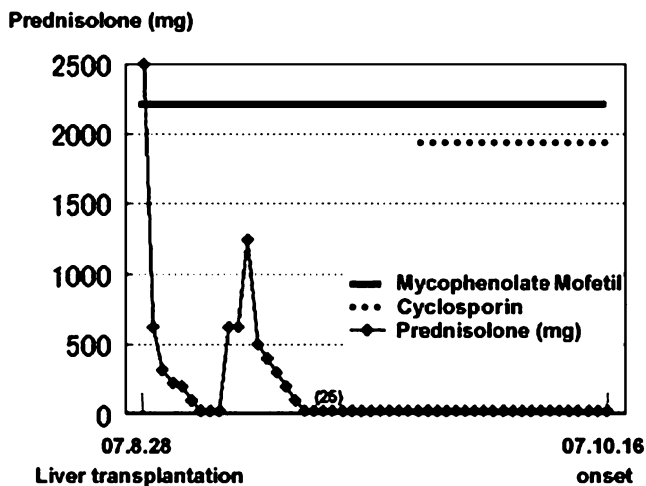


Fig. 1 Time course of the corticosteroid and immunosuppressive treatment from 28 August 2007, when the patient underwent liver transplantation, through 16 October 2007, when she presented with hip pain. *The value in parentheses is the daily doses of prednisolone*

MRI 3 weeks after the onset of pain showed an area of heterogeneous low signal intensity in the femoral head on the coronal T1-weighted image, and a corresponding area of high signal intensity on the T2-weighted image (Fig. 3a, b). In the axial slices on the T1-weighted image, an irregular, discontinuous, low-intensity band was observed which was convex to the articular surface and parallel to the subchondral bone end-plate (Fig. 3a). The low-intensity band was observed mainly in the anterior portion of the femoral head, which was interrupted in the middle portion (Fig. 3c). On the gadolinium-enhanced T1-weighted MR image of the same slice, both the low-intensity band and the central portion beyond the band showed high signal intensity (Fig. 3d), thus suggesting that the band and the proximal portion were both viable areas (not necrotic).

Based on the MRI findings, a subchondral insufficiency fracture was considered, and nonoperative treatment, such as bed rest and avoidance of weight bearing, was carried out. Partial weight bearing with the use of crutches was started 6 weeks after the onset of pain. Four months after

the onset, the patient reported no hip pain and a full range of motion in the right hip. Seven months after the onset, the irregular subchondral bone contour at the superior portion of the femoral head was no longer visible on the radiographs (Fig. 4a). On the follow-up MR image obtained 17 months after the onset, the band of low signal intensity previously seen in the right hip was not obvious, and only a small area of low signal intensity was observed on a T1-weighted image (Fig. 4b), while, on a T2-weighted image, an area of heterogeneous high signal intensity was still visible in the corresponding area (Fig. 4c).

Discussion

Patients who require long-term steroid use after organ transplantation are known to have a risk for the development of osteonecrosis [7]. The prevalence of osteonecrosis after liver transplantation has been reported to range from 2% to 8% [7, 8]. In the case reported herein, although osteonecrosis was initially considered, subchondral insufficiency fracture was diagnosed, based on the shape of the low-intensity band on the T1-weighted MR image, the findings of the enhanced MR image, and the timing of the onset of pain after liver transplantation.

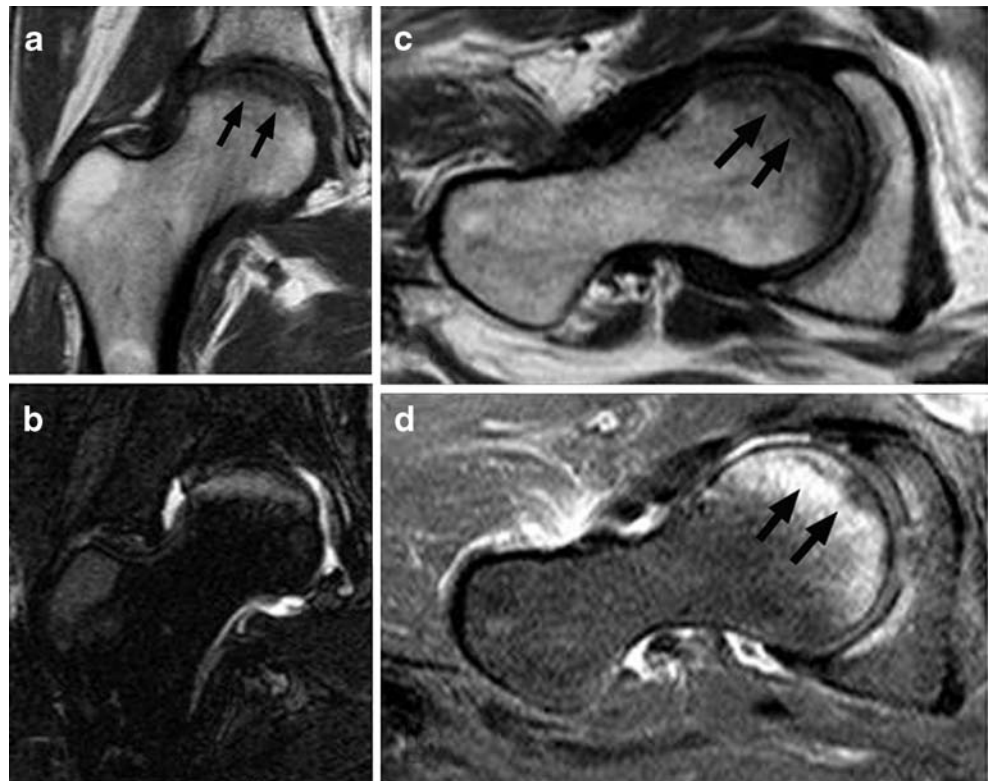
In a subchondral insufficiency fracture, one of the characteristic MRI findings is the shape of the low-intensity band on the T1-weighted images: it is generally irregular, serpiginous, convex to the articular surface and often discontinuous [1–4, 9, 10]. On the other hand, in osteonecrosis or avascular necrosis of the femoral head, since the low-intensity band represents repair tissue, it is generally smooth and circumscribes all of the necrotic segments [11–13]. In our patient, the shape of the low-intensity band on the T1-weighted image was irregular and serpiginous, and it was interrupted in the middle portion of the femoral head.

On the enhanced MR image of the subchondral insufficiency fracture, both the low-intensity band and the

Fig. 2 Radiograph 2 weeks after the onset of hip pain. A subchondral collapse is observed in the superolateral portion of the right femoral head (arrow)



Fig. 3 MRI findings 3 weeks after the onset of pain. **a, b** Coronal T1-weighted image [repetition time/echo time (TR/TE) 400/18 ms] (**a**) shows an area of heterogeneous low signal intensity in the femoral head, and there is a corresponding area of high signal intensity on the T2-weighted image (TR/TE 2,642/100 ms) (**b**). There is a band of very low signal intensity in the subchondral area on the T1-weighted image (*arrows*). **c** The axial slice of the T1-weighted image (TR/TE 400/18 ms) shows a low-intensity band which is observed mainly in the anterior portion and which is interrupted in the middle portion (*arrows*). **d** On the enhanced T1-weighted (TR/TE 652/18 ms) MR image (from the image shown in **c**), both the low-intensity band and the proximal portion beyond the band show high intensity (*arrows*)



proximal portion tend to show high intensity, especially in the early phase of the fracture [9]. In osteonecrosis, since the proximal portion beyond the band is an osteonecrotic area, it will not be enhanced. In our patient, both the low-intensity band and the proximal portion showed high intensity on the enhanced MR image, indicating that the band, as well as the proximal portion beyond the band, was viable and not necrotic.

Regarding symptoms, Lieberman et al. reported that symptomatic osteonecrosis became apparent from 26 months

to 38 months after liver transplantation [7]. Guichelaar and colleagues reported that osteonecrosis occurred in 27 of 360 patients at a mean of 2.4 years after liver transplantation [5]. In contrast, the hip pain in our patient had developed 7 weeks after transplantation.

An insufficiency fracture is a different condition from osteonecrosis at every stage. Based on 16 reported patients with clinical symptoms in whom epiphyseal abnormalities were seen on MRI after renal transplantation, Vande Berg and co-workers concluded that transient lesions suggested



Fig. 4 a A radiograph obtained 7 months after the onset of pain shows no progression of the collapse. **b** On the follow-up T1-weighted MR image [repetition time/echo time (TR/TE) 400/12 ms] obtained 17 months after the onset, only a small area of low signal intensity is

observed, mainly at the superior-medial portion. **c** On the follow-up T2-weighted (TR/TE 2,500/90 ms) MR image obtained 17 months after the onset, an area of heterogeneous high signal intensity is still visible in the corresponding area

insufficiency stress fractures, while irreversible lesions suggested osteonecrosis [3].

Gerot et al. reported one case of subchondral insufficiency fracture of the femoral head after liver transplantation, where the patient had been receiving long-term glucocorticoid therapy [6]. Our patient underwent a liver transplantation after a 12-year history of chronic liver disease, and she was treated with both high dosages of steroids (2,500 mg prednisolone per day) and two immunosuppressive agents. After the transplantation, the dosage of steroid was gradually decreased. Seven weeks after transplantation, she was being treated with cyclosporine, mycophenolate mofetil and 20 mg/day of prednisolone when she developed right hip pain. These clinical findings suggest that this patient had some degree of osteopenia in the femoral head relating to the usage of corticosteroids, although her BMD in the total hip area was within the normal range.

In conclusion, a subchondral insufficiency fracture of the femoral head needs to be considered in the differential diagnosis of hip pain in patients who have undergone liver transplantation.

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