

Intertrochanteric fracture in pregnancy- and lactation-associated osteoporosis

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Abstract

Pregnancy- and lactation-associated osteoporosis (PLO) is a special form of osteoporosis, which is the result of multiple factors affecting bone metabolism. The manifestations of PLO include severe low back or hip pain in the third trimester of pregnancy and postpartum period, and some patients present with a decrease in height and even fragility fractures. We report here a 33-year-old patient who presented with a left intertrochanteric fracture after falling from standing height at 10 months postpartum. She was diagnosed with PLO because of a considerable decrease in bone mineral density. Our findings are discussed in relation to the literature. Early diagnosis and timely and appropriate therapy are particularly important for PLO. PLO should be considered in patients who complain of low back or transient hip pain during pregnancy and lactation. Discontinuing breastfeeding and supplementing calcium/vitamin D should be recommended after diagnosis of PLO is established.

Keywords

Pregnancy- and lactation-associated osteoporosis, fragility fracture, bone mineral density, hip pain, breastfeeding, calcium, vitamin D

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Introduction

Pregnancy- and lactation-associated osteoporosis (PLO) is a rare clinical type of osteoporosis. The main pathophysiological changes of PLO include loss of maternal bone mass and reduction of bone mineral

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density (BMD).¹ A decrease in BMD is reported to be approximately 3% (30/1000 g) during pregnancy.² The typical clinical features of PLO are low back or hip pain and a decrease in self-awareness of height in the third trimester of pregnancy and postpartum.³ Fragility fractures may occur in women with severe osteoporosis, and predominantly occur in the thoracolumbar spine.⁴ The incidence of PLO is four in 1 million women and many of these patients are misdiagnosed.⁵ The etiology of PLO is unclear. A large amount of calcium delivered to the fetus and infants, and insufficient calcium intake during the third trimester of pregnancy and postpartum may contribute to osteoporosis.^{1,2,6} Diagnosing PLO or estimating the severity of osteoporosis during pregnancy is difficult because radioactive examinations are restricted to avoid exposure of the fetus to radiation. For postpartum women suspected as having PLO, investigation of the change in BMD with dual-energy X-ray absorptiometry (DXA) measurement contributes to determining diagnosis. In this report, we describe a patient who presented with an intertrochanteric fracture by falling in the postpartum period after her first delivery. She was diagnosed with PLO according to a decrease in BMD and a history of insufficient calcium/vitamin D intake. We focus on identifying the changes in BMD and calcium metabolic balance in pregnancy and lactation. We also discuss the factors that might increase the risk of PLO and fragility fractures, particularly hip fractures.

Case report

A 33-year-old female patient who was still breastfeeding 10 months after her first natural delivery visited our outpatient clinic because of a left intertrochanteric fracture caused by falling from standing height. Before her pregnancy, the patient had no

hypertension, diabetes mellitus, or other chronic diseases. She had no history of long-term drug use, smoking, or alcohol intake. She had not had any operations, did not suffer from hip or femur trauma, and had no family history of osteoporosis or hip fracture. During her pregnancy, the patient had no preeclampsia, eclampsia, gestational hyperthyroidism, or other metabolic diseases. She had no history of chronic diarrhea and never used glucocorticoids, heparin, or other drugs. Calcium 600 mg and vitamin D3 700 IU were supplemented every day during pregnancy, but she discontinued taking calcium and vitamin D after delivery. The patient had never complained about lower back or transient hip pain or a decrease in self-awareness of height during pregnancy and lactation. The patient experienced pain in the left hip after a fall, and could not stand on her left leg. At a physical examination, shortening deformity at the left leg was found, the range of motion in the left hip was restricted because of pain, and there was localized tenderness with palpation on the left hip. Percussion pain in the left lower limb was positive, but there was no tenderness in the spinal process in the thoracolumbar region and paravertebral muscles. Hip radiography (Figure 1a) showed a left intertrochanteric fracture. Although the patient never complained about low back pain, magnetic resonance imaging of the thoracic and lumbar spine identified a new compression fracture in the L1 vertebra with marrow edema (Figure 2). Laboratory test results are shown in Table 1. Serum calcium and parathyroid hormone concentrations were in the normal range, and 25-hydroxyvitamin D3 and albumin concentrations were low. BMD was measured with DXA, which showed a reduction in density in the hip and lumbar vertebrae (Table 2).

The patient was recommended to discontinue breastfeeding. Enhanced nutritional



Figure 1. X-ray images of a 33-year-old woman who was diagnosed with pregnancy- and lactation-associated osteoporosis. Preoperative (a) and postoperative (b) X-ray images of the pelvis and bilateral hip joints.



Figure 2. Sagittal T2 image of the thoracolumbar spine shows a new compression fracture in the L1 vertebra with marrow edema.

support, additional calcium (600 mg/day), and vitamin D (1200 IU/day) were provided, but she was not recommended to receive other anti-osteoporosis drugs, such as bisphosphonates and teriparatide. The patient underwent open reduction and internal fixation. She was administered dalteparin sodium (0.2 mL/day, 2500 IU) to prevent deep vein thrombosis during the perioperative period and pain was alleviated with celecoxib (cyclooxygenase 2 inhibitor). The patient was instructed to perform muscle strengthening exercises and moderately improve the range of motion in the hip and knee joints, but walking or standing with the left leg was temporarily forbidden.

The current report was approved by the ethical board of Capital University Friendship Hospital, Beijing, China. The patient gave verbal consent for scientific application and publication of her clinical data.

Discussion

PLO is the result of a change in bone metabolism and calcium balance caused

Table 1. Serum laboratory tests related to bone and mineral metabolism.

	Patient's results	Reference
Calcium (mmol/L)	2.24	2.11–2.52
Phosphate (mmol/L)	1.27	0.85–1.51
Alkaline phosphatase (U/L)	82	35–100
Osteocalcin (ng/mL)	15.66	17–43 (in premenopause) 15–46 (in postmenopause)
25-hydroxyvitamin D3 (ng/mL)	6.41	20–32
Albumin (g/L)	34.2	40–55
Hemoglobin (g/L)	99	115–150
Estradiol (pg/mL)	47.00	–
Progesterone (ng/mL)	0.28	–

Table 2. BMD results in the lumbar spine and hip.

Lumbar spine	BMD (g/cm ²)	T/Z-score	Hip	BMD (g/cm ²)	T/Z-score
L1	0.686	–2.8/–2.7	Neck	0.549	–2.7/–2.6
L2	0.709	–2.9/–2.9	Troch	0.477	–2.2/–2.2
L3	0.711	–3.4/–3.4	Inter	0.672	–2.8/–2.7
L4	0.677	–3.5/–3.5	Total	0.599	–2.8/–2.8
Total	0.695	–3.2/–3.2			

BMD: bone mineral density.

by biomechanical and hormonal factors during pregnancy and the lactation period.^{1,2} Comprehensive knowledge of changes in calcium metabolism, and characteristics of osteoporosis and fragility fractures are important in prevention, early diagnosis, and treatment of PLO.

A change in calcium metabolism during pregnancy and lactation results from hormone levels and a functional change in vital organs. Nearly 250 to 300 mg of calcium is estimated to pass to the fetus or infant per day through the placenta or by lactation in the mother.⁷ This process is thought to be main cause of calcium loss in PLO.² Increased absorption of intestinal calcium appears to be one of the most important compensatory mechanisms.² At the same time, mobilization of osteoclasts in the mother accelerates progress of bone reabsorption and helps to maintain the balance of calcium.⁸ Systemic low estradiol and

high parathyroid hormone-related protein concentrations synergistically stimulate osteoclast-mediated skeletal reabsorption during lactation.⁹ The role of the kidney in calcium metabolism is unknown. The kidney can increase the reabsorption capacity of calcium.⁷ Furthermore, renal calcium excretion can increase owing to greater renal reabsorption load caused by an increase in the glomerular filtration rate and calcium intake during pregnancy and lactation.⁶ Our patient presented with normal serum calcium and phosphate concentrations, and low vitamin D and albumin concentrations. The change in vitamin D concentrations may be related to two aspects as follows: 1) insufficient supplementation during the postpartum period; and 2) a decrease in vitamin D binding protein due to hypoalbuminemia. Low vitamin D concentrations could affect intestinal transport of calcium, and eventually cause

a reduction in calcium concentrations. We consider that serum calcium concentrations should be maintained by other compensatory mechanisms.

In our case, low BMD in the lumbar vertebra and hip contributed to the diagnosis of PLO. Changes in BMD in the vertebrae and hip are different, depending on lactation stages.^{1,6} For breastfeeding mothers, BMD of the vertebrae and hip are decreased in early postpartum, and this decrease in the vertebrae is more than that in the femoral neck.¹⁰ BMD further decreases among those who keep breastfeeding, but BMD in the vertebrae can recover after early weaning.¹ For non-breastfeeding mothers, there is no significant decrease in BMD during the first 5 months postpartum.¹⁰ The difference in change between the vertebrae and hip may be related to their different bone composition (the vertebrae are rich in trabecular bone and the hip is rich in cortical bone).

Although many studies have focused on risk factors of perimenopausal or postmenopausal osteoporosis, few studies have investigated the risk factors of PLO. Possible risk factors of PLO include the duration of lactation and the age of first delivery.¹¹ Heparin and glucocorticoid treatment during pregnancy, prolong lactation, and insufficient physical activity before and after puberty may contribute to PLO. Low body weight in childhood and puberty is a possible risk factor for PLO.⁴ In some cases, women with PLO have genetic or skeletal disorders. Butscheidt et al determined the potential effect of gene mutation (*LRP5*, *COL1A1*, and *COL1A2*) on bone loss in PLO.¹²

Fragility fractures primarily occur in the first pregnancy, particularly in the third trimester of pregnancy or in the first month postpartum.⁴ Vertebral fractures are more common than hip fractures.³ Risk factors of fragility fractures for PLO are unclear.¹³ For hip fractures, obesity (body mass index

of ≥ 30 kg/m²) was reported as a protective factor for hip fractures.¹⁴ A shortened breastfeeding period may help to reduce the risk of fragility fractures in PLO.

There is no guideline for prevention and treatment of PLO. Therefore, we recommend the following for primary osteoporosis. 1) Lifestyle management, including strengthening nutritional support and having a balanced diet, is important. Patients should ensure that they have sufficient exposure to sunshine and regularly exercise. 2) Essential bone health supplements are important, including appropriate intake of calcium and vitamin D. For Chinese adults, supplementation of 800 mg calcium per day is recommended, while the average intake of calcium should be approximately 400 mg in the diet per day.¹⁵ Therefore, additional calcium is important for mothers, particularly those who are diagnosed with PLO. The recommended daily allowance of vitamin D is 800 to 1200 IU/day.¹⁶ 3) Pharmacological treatment, such as bisphosphonates and parathyroid hormone analogues (e.g., teriparatide), is important for primary osteoporosis. Teriparatide may be an effective medical choice. A 23-year-old patient who was treated with teriparatide after being diagnosed with PLO showed a considerable increase in BMD.¹⁷ In our case, calcium and vitamin D supplementation almost met the patient's daily requirement during pregnancy, but her intake of calcium stopped at postpartum, which may have caused calcium deficiency. Our patient never received a suggestion to accept pharmacological treatment for spontaneous recovery of BMD after the weaning.¹⁸ Whether bisphosphonates and teriparatide will have an effect on any future pregnancy is unclear.

An operation is essential for patients with PLO and a hip fracture. Open/closed reduction internal fixation or hip arthroplasty is available for these patients.

Our patient underwent an open reduction internal fixation operation, and achieved good reduction and fixation (Figure 1b).

Anticoagulants to protect against deep vein thrombosis are necessary in the perioperative period for patients with PLO and fragility fractures. Our patient was treated with dalteparin (0.2 mL, 2500 IU/day). A history of heparin may increase the risk of PLO.⁴ However, whether use of heparin in patients with PLO may cause more severe osteoporosis or affect the efficacy of anti-osteoporosis therapy is unknown.

Clinicians should keep PLO in mind, especially for patients complaining of low back or transient hip pain with pregnancy and lactation. Furthermore, excluding other secondary factors that may cause osteoporosis is important before diagnosis. Pharmacological treatment may be an effective option for PLO, but its safety to the mother and fetus remain to be properly determined.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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