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Short Communication

Bone Mineral Density in Children with Juvenile Chronic Arthritis

A. Çetin[1], R. Çeliker[1], F. Dinçer[1], M. Ariyürek[2]

Departments of [1]Physical Medicine and Rehabilitation and [2]Radiology, Hacettepe University, School of Medicine, Ankara, Turkey

Abstract: The aim of this study was to evaluate bone mineral density changes in patients with juvenile chronic arthritis (JCA) and to determine the most likely causes of osteoporosis in these patients. Eighteen (11 male, 7 female) patients suffering from JCA and 14 healthy controls (10 male, four female) were included in this study. The mean age of the patients and control groups were 11.0 ± 3.2 and 10.9 ± 2.9 years respectively. Disease activity was determined by clinical and laboratory evaluation and 'Articular Disease Severity Score' (ADSS). Bone mineral density (BMD) of the femoral neck and lumbar spine was measured by dual photon absorptiometry.

BMD of the patients at the lumbar spine was significantly lower than the control group ($p < 0.05$). This difference was more marked in patients treated with steroids. Femoral neck BMD was also lower in the patient group but this difference was not statistically significant. There was a negative correlation between ADSS and BMD at the spine. In conclusion, trabecular bone loss is characteristic for osteoporosis in JCA. Our results indicate that steroid treatment and disease severity are important factors in the development of osteoporosis in JCA.

Keywords: Juvenile chronic arthritis; Osteoporosis

Introduction

Osteoporosis is commonly observed in children with juvenile chronic arthritis (JCA) [1–4]. The precise mechanisms that produce osteopenia in these children are not completely understood [3,4]. Previous studies have shown that osteoporosis in JCA has a multifactorial origin [1,2,4]. Reduced or absent physical activity [1,2,4–7], decreased production of endogenous vitamin D [1,2,6], anaemia [7] and drug treatment, especially steroid treatment [1,2,4–7], are thought to be possible mechanisms of osteoporosis in children with JCA. In some studies it is reported that activity of the disease [1,4,6,7], the number of joints involved [1] and the duration of active disease [1,6] are related to the severity of osteoporosis of these patients. The purpose of this study was to evaluate bone mineral density (BMD) changes in patients with JCA by using dual photon absorptiometry (DPA) and to determine the most likely causes of osteoporosis in these patients.

Patients and Methods

Eighteen (11 male, seven female) patients suffering from JCA, who were referred to the outpatient clinic of the Department of Physical Medicine and Rehabilitation at Hacettepe University Hospital, were included in this study. None of the children had a history of any other diseases influencing bone metabolism. The control group consisted of 14 (10 male, four female) healthy children. The mean age of the patients was 11.0 ± 3.2 years (range 4–14 years) and the mean age of the control group was 10.9 ± 2.9 years (range 5–15 years). Patients underwent a clinical and laboratory assessment of disease activity. Clinical activity was determined by the 'Articular Disease Severity Score' (ADSS), which was given on the basis of joint swelling, pain on passive motion and limitation of joint motion. All the scores ranged from 0 to 3 (0 = none, 1 = mild, 2 = moderate, 3 = severe). The ADSS was calculated by summing all scores [8].

BMD was measured by DPA (Philips, Osteotech 300 Dual Photon Scanner, Version 2.0). BMD of the femoral

Correspondence and offprint requests to: Associate Professor R. Çeliker, MD, Department of Physical Medicine and Rehabilitation, Hacettepe University, School of Medicine, 06100 Ankara, Turkey. Tel/Fax: 90–312–3105769.

neck and lumbar spine was measured and expressed in g/cm^2. Statistical analysis was performed using Pearson's correlation matrix, Student's *t*-test, analysis of variance and the Duncan test.

Sixteen of the 18 patients had polyarticular disease, one had pauciarticular JCA and the other had systemic JCA. The patient with pauciarticular JCA and eight of the patients with polyarticular JCA had been using corticosteroids. The hip was the most affected joint (78%), followed by the knee (56%), wrist (50%), elbow and ankle (33%). It was not possible to calculate the mean daily dose or the mean cumulative dose of steroid from patient records but the minimum duration of steroid therapy was 1 year and the minimum dose of steroid was 5 mg/day of prednisone or prednisone equivalent. There were no significant differences in the mean age, height and daily calcium intake between the patient and control groups, but body mass index and weight of the patients were lower than the control group ($p<0.05$).

Results

BMD of the patients at the lumbar spine was significantly lower than the control subjects (0.628 ± 0.091 and 0.800 ± 0.111, respectively, $p<0.05$). Femoral neck BMD was also lower in the patient group but this difference was not statistically significant (0.648 ± 0.180 and 0.692 ± 0.231, respectively, $p>0.05$). BMD of the spine was lower in patients taking steroids compared with patients on other medications. However, BMD of the spine of patients without corticotherapy was lower than the controls, but BMD of the femoral neck was not significantly different between these groups, as presented in Table 1. The mean ADSS was 29.94 ± 17.16, duration of disease was 5.61 ± 2.73 years, serum level of haemoglobin was 11.04 ± 3.13 g/dl and erythrocyte sedimentation rate (ESR) was 65.72 ± 36.38 mm/h. In the patient group there was no correlation between BMD and ESR, duration of disease and haemoglobin level. However, we demonstrated a negative correlation between ADSS and BMD at the spine ($r = -0.48$, $p<0.05$). There was a positive correlation between age and lumbar spine BMD in both the patient and control groups ($p<0.05$).

Table 1. Bone mineral density values of the patients on steroids, not on steroids and controls

	On steroids (n=9)	Not on steroids (n=9)	Controls (n=14)
L2	0.564±0.071*#	0.707±0.055	0.799±0.119
L3	0.586±0.080*#	0.715±0.056#	0.816±0.121
L4	0.599±0.124#	0.708±0.064	0.780±0.113
Lavrg	0.579±0.085*#	0.678±0.069#	0.800±0.111
Femur	0.669±0.231	0.630±0.085	0.692±0.231

Data expressed as mean ± standard deviation.
#$p<0.05$, compared with control group.
*$p<005$, compared with patients not on steroids.

Discussion

A variety of congenital or acquired childhood diseases such as JCA may affect bone mineralisation. Although there are more sensitive methods than DPA, it offers a none-invasive measurement of BMD. A decrease in skeletal mass could be quantitated and documented early in disease by DPA [1,6]. The results of this study indicated that BMD of patients with JCA, measured by DPA, was 10–20% lower than that of healthy control children. This decrease was more marked in trabecular bone than in cortical bone. It has been shown that, similar to our study, the hip and knee are the most frequently involved joints in JCA [9]. That is why these children have decreased activity and muscle stress on bone. On the other hand, high rates of hip involvement and secondary degeneration of the joint may be responsible for the relatively higher BMD of the femoral neck. Children with JCA have to take many medications, such as non-steroidal anti-inflammatory drugs and corticosteroids that have significant effects on bone and its mineralisation [1,2,6]. It has been recognised that when supraphysiological levels of corticosteroids are maintained chronically in humans, severe bone mass loss can result with a characteristic distribution that is more severe in trabecular bone regions of the skeleton and less striking in the long bones [1,2]. The incidence of symptomatic corticosteroid induced osteopenia seems to be highest in growing children and postmenopausal women [7]. In children a high bone turnover rate and rapid skeletal remodelling are factors that predispose to the rapid occurrence of severe bone loss [7]. The mechanisms of corticosteroid induced osteoporosis are still not fully understood. Bone resumption may be related to secondary hyperparathyroidism due to either a direct stimulatory effect of corticosteroids on parathyroid hormone secretion or indirectly as a consequence of depressed calcium absorption [7]. Corticosteroids also have a suppressive effect on osteoblasts [10]. Bardare et al. [2] suggested that steroids decrease BMD by means of decreasing 25-OH-Vitamin D levels. However, in a study by Reed et al. [4] it is suggested that reduced bone mass in patients with JCA is not related to the use of steroids. In this study we observed that patients on steroids showed a significantly reduced lumbar BMD when compared with the patients not on steroids. This result has confirmed the role of corticosteroids on trabecular bone loss reported in the literature. Some investigators have reported that in patients with JCA, disease duration and activity may lead to trabecular bone loss as a result of elevation of circulating levels of proinflammatory cytokines and immobilisation caused by disease activity [1,6]. In our study there was a statistically significant negative correlation between the ADSS and lumbar BMD, as in the literature. Conversely, we could not find any correlation between ESR, disease duration and BMD. This may be due to the anti-inflammatory effects of corticosteroids on active joints.

In conclusion, data obtained from our preliminary study suggest that trabecular bone loss is characteristic

for osteoporosis in JCA. This trabecular bone loss in JCA is certainly of multifactorial origin. Our results indicate that steroid treatment and disease severity are more important factors than others in the development of JCA osteoporosis. In planning treatment for these children, corticosteroids should be considered the last drug of choice and if they are necessary the lowest dose possible must be preferred to minimise side-effects.

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