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ORIGINAL ARTICLE

Clinical significance of bone mineral density in Ankylosing Spondylitis patients: Relation to disease activity and physical function

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Abstract *Aim of the work:* The aim of this work was to assess the bone mineral density (BMD) in Ankylosing Spondylitis (AS) patients and to investigate its relation with clinical and laboratory parameters, imaging of sacroiliac joints, disease activity and physical function.

Patients and methods: 44 patients were recruited from the Rheumatology outpatient clinic of the Kasr El-Aini Hospital, their mean age was 33 ± 8.7 years. Twenty age and sex matched subjects were included as controls. Dual energy X-ray absorptiometry (DEXA) was performed for the patients and control. Disease activity and physical function were assessed using the Bath AS Disease Activity Index (BASDAI) and Bath AS Functional Index (BASFI), respectively.

Results: The *T*-scores of the spine, hip and forearm were lower in patients compared to controls. Low BMD was more found among patients with chronic sacroiliitis. There were significant negative correlations between chin to chest and occiput to wall distance and BMD at the hip and forearm (both $p < 0.05$). The BMD at the spine showed a significant correlation with the BASDAI ($p = 0.008$) and BASFI ($p = 0.03$). There was no correlation between BMD at any site and patients' age, disease duration, inflammatory back pain duration, modified Schöber's test, finger-to-floor test and laboratory parameters.

Conclusion: The BMD was remarkably decreased at all measurement sites in AS patients. The BMD at the spine significantly negatively correlated with the disease activity and physical function. Bone loss in AS can be explained partly by the role of inflammatory mediators and partly as a consequence of reduced physical activity.

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1. Introduction

Ankylosing Spondylitis (AS) is a chronic inflammatory rheumatic disease, mainly affecting the sacroiliac joints, vertebrae and intervertebral discs, leading to syndesmophyte formation and impaired back mobility [1].

In AS two enhanced but opposite bone remodelling processes are taking place in close vicinity within the spine which are pathologic new bone formation in the cortical zone of the vertebrae, the zygapophyseal joints, and the ligamentous apparatus and excessive loss of trabecular bone in the centre of the vertebral body leads to osteoporosis [2]. An increased prevalence of osteoporosis and significantly lower bone mineral density (BMD) in AS patients compared with sex and age matched controls have been demonstrated [3,4]. Measurement of bone mass is useful in diagnosing osteoporosis commonly observed in the lumbar spine and the femoral neck but not in the appendicular skeleton. Osteoporosis is seen early in the disease whereas increased bone mass is observed later or due to syndesmophyte formation. Osteoporosis in AS is probably a multi-factorial condition. Contributing factors are spine immobility secondary to ankylosis, inflammatory cytokines which enhance bone resorption, prolonged use of nonsteroidal antiinflammatory drugs (NSAIDs) and a deficit in sex hormone secretion [3,5]. Furthermore, there is no alteration in calcium or phosphorus metabolism in AS [6]. The only evidence-based recommendation is that optimal control of disease activity in AS prevents bone loss. A beneficial effect of infliximab therapy on bone turnover markers and BMD in AS has been shown; bisphosphonates may be useful in managing osteoporosis in AS [7].

Several surveys have reported the prevalence of vertebral fractures in AS patients [3,8,9]. These studies indicate that vertebral fractures are a regular finding in patients with AS but their prevalence is highly variable. These differences are at least in part a reflection of differences in recruitment methods (e.g. consecutive patients, selected patients based on disease activity or occiput-to-wall distance, sex distribution, age and clinical versus systematic morphometric fractures) and the definition of vertebral fractures. A detailed description of vertebral fractures in AS appears to be derived from the study by Cooper and colleagues [10]. This retrospective population-based study on clinical fractures reported an increased odds ratio (OR) of 7.7 (95% confidence interval 4.3–12.6) for clinical vertebral fractures. The cumulative incidence of clinical vertebral fractures was higher in men (OR 10.7 versus 4.2 in women) and increased during the first 5 years of the disease, peaking at 17%, 20–30 years after diagnosis. Of interest, the cumulative incidence of nonvertebral fractures was similar to the control population. As this population study involved clinical vertebral fractures, it still remains unclear what is the exact prevalence and incidence of morphometric vertebral fractures in AS.

The aim of this work was to assess the bone mineral density (BMD) in Ankylosing Spondylitis (AS) patients and to investigate its relation with clinical and laboratory parameters, imaging of sacroiliac joints, disease activity and physical function.

2. Patients and methods

In this cross-sectional study, 44 Ankylosing Spondylitis (AS) patients were recruited from the Rheumatology outpatients clinic Kasr El Aini Hospital, Faculty of Medicine, Cairo University. Patients were diagnosed according to the modified New York criteria [11]. Patients with any condition or treatment that might have affected bone metabolism (malabsorption, chronic renal and liver diseases, thyroid diseases, alcoholism, corticosteroids, anticonvulsants) and patients with other forms of spondyloarthropathies were excluded. The control group consisted of 20 age- and sex-matched healthy subjects without a history of inflammatory rheumatic disease, conditions or medication responsible for bone loss. The study was approved by the local ethics committee and was performed in accordance with ethical standards of the 1964 Declaration of Helsinki. Patients gave informed consent to be included in the study.

Demographic and clinical variables were recorded from all patients including age, disease duration, age of disease onset, peripheral arthritis, axial joints involved and uveitis.

Functional status and measures of disease activity and severity were obtained using established methods. Functional ability was assessed by Bath Ankylosing Spondylitis Functional Index (BASFI) [12]. BASFI is a set of 10 questions designed to determine the degree of functional limitation in AS. It is a self-assessment tool where a 100 mm horizontal visual analogue scale (VAS) is used to answer the questions that reflect the ability to perform specific tasks. The mean of the ten scales gives the BASFI score, value between 0 and 100.

Disease activity was measured by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) [13]. The BASDAI is also a self-assessment tool that evaluates a range of symptoms. Like the BASFI, the BASDAI consists of 100 mm horizontal VAS used to answer 6 questions pertaining to the 5 major symptoms of AS: fatigue, spinal pain, pain and swelling in other joints, discomfort with peripheral entheses and severity and duration of morning stiffness. To give each symptom equal weighting, the mean of two scores relating to morning stiffness is taken. The resulting score is then divided by 5 to give the final BASDAI score (0–100).

Spine mobility was assessed using the modified Schöber's test [14]. We have also recorded the patients' medication history including intermittent or continuous use of NSAIDs, disease-modifying drugs (DMARDs) and tumour necrosis factor-alpha (TNFα) blockers (Infliximab, Etanercept and Adalimumab). Sacroiliac and lumbosacral MRI were examined in order to grade the sacroiliitis that was defined by signal characteristic of the joint space, presence of bone marrow oedema or erosion adjacent to the joint (according to New York criteria) and to assess the syndesmophytes [15]. Chronic sacroiliitis was defined by low signal intensity on T1 and T2 weighted images, subchondral sclerosis, joint space narrowing and bone bridging. While, the presence of erosions as high signal intensity on T2 image, subchondral oedema and enhancement within or adjacent to the sacroiliac joint were considered markers of active inflammatory lesion. Inflammatory activity was also measured by erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) (by ELISA, normal values < 5 mg/L).

Bone mineral density (BMD) was measured at the postero-anterior (PA) lumbar spine (L2–L4), forearm and hip by means of dual energy X-ray absorptiometry (DEXA). Results were expressed as *T*-score (standard deviation from peak adult BMD). According to the WHO criteria, osteopenia was defined as *T*-score between -1 and -2.5 and osteoporosis as a *T*-score below -2.5 [16].