Bone Mineral Density Assessment in Rheumatoid Arthritis Using Dual- Energy X- Ray Absorptiometry

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Abstract:

Objectives: To determine the bone mineral density (BMD) status of our rheumatoid arthritic patients by frequency and severity and to investigate correlation between BMD status with the disease activity and duration.

Patients & Methods: Eighty five Iraqi patients who had fulfilled the criteria for rheumatoid arthritis established by American College of Rheumatology (ACR) were enrolled in this study between December 2003 and April 2004. Clinical data regarding disease activity and its duration were reported. BMD measurements of the lumber spine (L1 – L4) were performed using Dual Energy X- Ray Absorptiometry (DEXA). T. scores were calculated from the BMD data.

Results: A total of 85 patients were assessed, 75 were females and 10 were males with a mean age of 45 years. Twenty nine had normal BMD, Forty had osteopenia and sixteen had osteoporosis.

The disease duration was classified into 3 subgroups, short (< 3 years, 23%), intermediate (3 – 6 years, 38.8%), and long (> 6 years, 37%) disease duration with a T. score means (-1.16), (- 0.99) and (- 1.05) respectively.

At the time of their baseline BMD measurements, 10 patients had active disease (8 of them on prednisone 10 mg/day) with disease duration mean of ± SD (7.5 years ± 3.9) and T. score mean ± SD of (- 3.02 ± 0.6), while (75) patients whose disease was in remission (inactive) had disease duration mean ± SD of (6.08 years ± 15.6) and T. score mean ± SD of (-1.1 ± 1.3). Persistent or frank reduction of BMD measurements was documented among all patients who had ongoing active disease ($p < 0.001$). In spite of the importance of the longer disease duration in relation to the BMD reduction, the differences which we obtained did not achieve statistical significance ($p > 0.05$).

Conclusion: Low bone mass density (osteopenia and osteoporosis) is common in patients with (R.A.), and it usually worsens with disease activity and severity.

Key words: Osteopenia, Osteoporosis, DEXA.

Introduction

Rheumatoid arthritis (R A) is a systemic inflammatory disease predominantly manifests in the synovial membrane of diarthroidal joints. The severity of (R A) encompasses a wide spectrum ranging from self limiting disease to chronic progressive disease, causing varying degrees of joints destruction and clinically evident extra-articular organ involvement. This clinical heterogeneity is determined by genetic and environmental factors that control the progression, degree and pattern of inflammation [1].

Bone density, a measure of bone mass, can be measured non-invasively using wide available densitometric techniques [2].

Bone mass measurements are to diagnose osteopenia or osteoporosis, predict fracture risk and monitor the response of bone mineral density (BMD) to therapy. Measurement devices are categorized by whether they measure the central skeleton (spine and hip) or the peripheral skeleton (finger, heel, tibia or wrist…). The Dual Energy X-Ray Absorptiometry (DEXA) is the central device most commonly used. However, all of these devices are precise and accurate, but the central DEXA has software to measure total body bone mass, body composition and vertebral morphometry. [3]

One purported advantage of DEXA technique is that it allows evaluation of cancellous (trabecular) bone in the middle of the vertebrae because it does not measure overlying cortical bone and posterior elements of the vertebrae. The cancellous bone has tremendous surface area and is more rapidly affected during bone loss than is cortical bone [4]. R. A is one of many disorders considered as a cause of low bone mass and many of patients receive low doses of prednisone (5---7.5 mg/day), so significant osteoporosis may develop within (6) months of initiating corticosteroid therapy [5].

Osteoporosis is a major clinical problem in chronic inflammatory diseases such as R.A [6].

The World Health Organization (WHO) has defined low bone mass (osteopenia) in woman as a bone mineral density (BMD) between (1.0 and 2.5) standard deviations (SDs) below the mean for young adult woman, it defines (osteoporosis) as a bone density equal to or greater than (2.5 SDs) below the young adult mean. [7]

The modern treatment strategy in R.A involves use of aggressive therapy to suppress inflammation and minimize joint destruction, followed by prompt therapy adjustment if it is recognized that these treatment goals are not being achieved. Optimal implementation of this strategy requires sensitive methods for diagnosis and monitoring of the disease as well as for determining the prognosis [8].

The aims of this study were to determine the frequency and severity of low bone density among our rheumatoid arthritic patients and to investigate correlation between BMD status and disease activity and duration.

Patients &Methods:

Eighty five Iraqi patients who had fulfilled the criteria for rheumatoid arthritis established by American College of Rheumatology (ACR) [9] were enrolled in this cross sectional study which was conducted at Baghdad Teaching Hospital, Department of Rheumatology between 1st of Dec 2003 and 15th of April 2004. Disease activity was assessed according to the presence of muscle weakness, fatigability, and duration of morning stiffness, number of swollen and tender joints and elevated Erythrocyte Sedimentation Rate (ESR) [10], and degree of impairment of functional status [11]. Patients were subdivided into active or inactive clinical subgroups. Those with inactive disease criteria were intended to describe either spontaneous remission or a state of drug induced disease suppression (including Corticosteroids) which simulate spontaneous remission [10], while those with active disease defined according to their clinical features and laboratory findings, as well as impairment of daily living activities (DLAs) performance in addition, the duration of disease was classified as short (< 3 years), intermediate (3-6 years) or long (> 6 years) disease duration [12]. At the time of BMD measurement, non of the patients had another disease such as (Diabetes-Mellitus, hyperparathyroidism, hyperthyroidism, multiple myeloma or renal failure) and none were receiving medications known to affect bone metabolism other than corticosteroids.

BMD measurement:-

All BMD measurements were obtained with DEXA instrument at Specialized Center of Endocrinology and Diabetes and performed on the antero- posterior lumber spine (L1 – L4) views.

This site was chosen because of its pathophysiologic relevance to vertebral changes and compression fractures [13]. BMD measurement was expressed as T. score considering the diagnostic criteria for osteoporosis established by WHO [14].

For the purpose of this study, the following values were used,

Normal = BMD T score greater than (-1) (T-score > - 1).

Osteopenia = BMD T score between (-1 & -2.5)

Osteoporosis = BMD T score less than (- 2.5).

These values were chosen to maintain consistency with WHO standards [15].

Statistical analysis:-

Statistical analysis was performed as t- test, chi Square and linear regression test and $P<0.05$ was considered significant.

Results

Demographic and Clinical Data:-

A total of 85 Iraqi patients were included in this study.

Seventy five patients were female (34 of them were menopause) and ten patients were male with a mean age at participation of (45) years (range from 21 to 71 years).

Twenty nine (2 male, 27 female) had normal BMD measures, Fourty (6 male, 34 female) had osteopenia and sixteen (2 male, 14 female) had osteoporosis as shown by table (1) and figure (1).

Table (1) BMD measurements (T. score) by gender among 85 Rheumatoid arthritic patients

BMD measurements (T. score) level	Gender		Number of patients	%
	Male	Female		
Normal > - 1.0	2	27	29	34
Osteopenia (- 1.0 to – 2.5)	6	34	40	47
Osteoporosis (< - 2.5)	2	14	16	19
Total	10	75	85	100

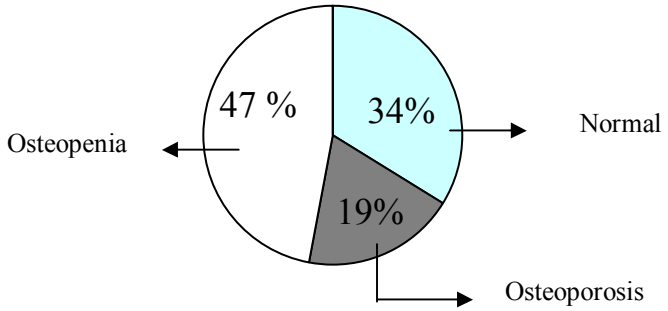

Figure (1) BMD measurements in 85 rheumatoid arthritic patients.

The disease duration classifications with the BMD measurements are shown in table (2), there were 20 patients (33%) of less than 3 years (< 3 years), 33 patients (38%) of (3 – 6 years) and 32 patients (37%) of more than 6 years (> 6 years) disease duration.

The means of disease duration were (1.9) years, (3.87) years and (11.84) years among < 3 years, 3- 6 years and > 6 years sub groups respectively, while the BMD measurement (-.Score) showed means of (- 1.16), (- 0.99) and (- 1.05) among < 3 years, 3 – 6 years and > 6 years respectively as illustrated in table 3.

At the time of their baseline BMD measurements, 10 patients had active disease and (75 patients) had inactive disease (Table 4). The disease duration mean ±SD for patients in the active disease group was (7.5 years ± 3.9) range (3–15 years), while the mean ± SD duration of disease for patients in remission (inactive group) was (6.08 years ± 15.6) (range one year to 26years).

There were no statistically significant differences between disease duration and the BMD measurements ($r = -0.78$) and ($p > 0.05$).

The patients of active disease had BMD measurements mean ± SD (T-score) (– 3.02 ± 0.6), the remaining patients who were in state of remission, their BMD mean ± SD (T-score) was (1.1 ± 1.3).There were strong association between disease activity and significant reduction in BMD measurement ($p < 0.001$).

Most of the patients were receiving ≥ 1 disease modifying antirheumatic drugs (DMARDs), Methotrexate was the most frequently used drug (n= 76), followed by chloroquine (n= 60), oral corticosteroid (prednisone) (n=15) (8 active, 7 inactive disease) and D. penicillamine (n=2), while nonsteroidal anti-inflammatory drugs (NSAIDs) were taken by most of patients irregularly.

Table (2) Disease duration classifications and BMD measurements among 85 rheumatoid arthritic patients.

Disease Duration Category	n = 85	BMD measurements (T. score)			%
	No. of patients	Normal (> - 1.0)	Osteopenia (- 1.0 - - 2.5)	Osteoporosis (< - 2.5)	
< 3 years	20	8	10	2	23
3 – 6 years	33	9	19	5	38.8
> 6 years	32	12	11	9	37.6
Total	29	40	1		

Table (3) Disease duration means and BMD measurement means by disease duration subgroups in 85 patients with Rheumatoid arthritis.

Disease duration subgroup	n = 85	Disease duration mean (years)	BMD measurement (T. score) mean
	No. of patients		
< 3 years	20	1.9	- 1.16
3 – 6 years	33	3.87	- 0.99
> 6 years	32	11.84	- 1.05

Table (4) Disease duration classifications by disease activity groups in 85 patients with Rheumatoid arthritis.

Disease duration subgroup	Inactive cases	Active cases	Total
< 3 years	20	0	20
3 – 6 years	27	5	32
> 6 years	28	5	33
Total	75	10	85

Discussion

Strength and integrity of our bones depend on maintaining a delicate balance between bone resorption by osteoclasts and bone formation by osteoblasts. As we aged or as a result of disease, this delicate balancing act becomes tipped in favor of osteoclasts, so that bone resorption exceeds bone formation rendering bones brittle and prone to fracture [16].

The etiology of bone loss in (R.A) was multifactorial, including local inflammation, release of bone absorbing cytokines, physical inactivity and malnutrition, in addition to the use of corticosteroids [17].

The data presented in this paper shows that there is significant reduction in BMD among patients with (R. A) even with those of inactive disease (66%).

Rheumatoid arthritis itself has a risk factor for osteoporosis, in addition to the medications used like corticosteroids and methotrexate (MTX) [18].

An important observation in this study was no significant correlation could be detected between the decrease of BMD and disease duration. As demonstrated in table (3), the mean of T- score for < 3 years subgroup was (-1.16) which was lesser compared with the T. score mean of > 6 years subgroup which was (-1.05) as well as of 3–6 years subgroup (- 0.99). The possible explanation for this finding is that the severity of disease was more frequent in patients with <3 years duration subgroup compared with that patients of long duration, considering that to distinguish activity from severity of the disease depending on many factors controlling the progression, degree and pattern of the inflammation [2].

Moreover, the decrease in bone formation may, in part precede the clinical onset of arthritis [19]. (R. A) patients have lower bone mass as compared with normal and substantial loss may occur early after the onset of disease [20].

The data as illustrated in this study showed also that, there was significant association of BMD reduction with the disease activity. These findings are consistent with previous reports of an association between disease activity and significant reduction in BMD [21].

High risk of osteoporosis in people with R.A is caused by disease activity, medication effects, physical inactivity and standard risk factor such as postmenopausal status [22].

In conclusion, BMD reduction is significantly associated with R. A patient even in those who showed inactive disease or short disease duration.

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