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Value of Screening for Osteoporosis among Children with Juvenile Idiopathic Arthritis

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ABSTRACT

Background: Juvenile idiopathic arthritis (JIA) is one of the most common rheumatic diseases in children. In all subtypes of JIA, a low bone mass has been detected in a high percentage of children due to failure to develop adequate bone mineralization.

Objective: To determine the extent of osteoporosis among children with JIA.

Patients and Methods: A cross sectional study on thirty patients diagnosed with JIA. In addition, age and sex matched thirty healthy children worked as control. Bone mineral density (BMD) and Z score of lumbar spine, neck of the femur and distal radius were analysed and adjusted for age and sex among patients and controls. Lunar DPX-NT 2013 made in USA by General Electric did dual energy X-ray absorptiometry (DEXA) scan.

Results: 60% of patients were males with a male to female ratio of 3:2. Our patients' age ranged between 6-15 years. The disease duration ranged between 6 months and 10 years. We found that 24 patients (80%) had osteoporosis (age-matched Z score was below normal), while among the control group only 4 children (13.3%) had osteoporosis. There was a significant difference between patients and controls regarding DEXA scan findings. Patients with longer duration of JIA at diagnosis had more osteopenia and osteoporosis than those with short duration of disease. The mean ± SD of disease duration in patients with JIA who were suffering from osteoporosis was 5.1 ± 2.76 years. In oligoarticular type, majority of the cases had osteoporosis 40% (12 patients). In systemic onset JIA 8 cases (26.7%), six of them were osteoporotic. The psoriatic type was diagnosed in four patients (13.3%), all of them were osteoporotic. The polyarticular RF +ve type was diagnosed in four patients (13.3%), half of them were osteoporotic and the polyarticular RF -ve type was diagnosed only in 2 patients (6.7%), all of them were within normal bone density.

Conclusion: Results obtained from this study suggest that osteoporosis was a frequent complication of JIA. JIA patients are likely to have low BMD. Children with JIA who have oligoarticular and systemic onset of JIA patients were more susceptible to low BMD.

Keywords: JIA, Osteoporosis, DEXA.

INTRODUCTION

Osteoporosis is a major health problem worldwide characterized by low bone mass and micro-architectural deterioration, which increase bone fragility and increase risk of fracture [1, 2]. Children with symptomatic osteoporosis present with a history of recurrent low impact fractures or moderate to severe backache [3].

Increasing awareness among paediatricians to identify risk factors and the clinical conditions or diseases that could lead to development of osteoporosis made them screen for possibility of asymptomatic osteoporosis in children with rheumatological disease. JIA is the most common rheumatological disease in children [4] and the prevalence of JIA varies between 3.83 to 400 cases/100,000 children [5]. Low BMD is expected in children with chronic connective tissue diseases, as JIA, systemic vasculitides, juvenile dermatomyositis and juvenile systemic lupus erythematosus (SLE) [6].

As osteoporosis in children has a considerable burden of morbidity, so special effort should be considered to prevent its complications. DEXA scan is a diagnostic tool used for measuring BMD [5, 7].

In adults, osteoporosis is defined as a bone density of 2.5 standard deviations (SD) below the mean in dual emission x-ray absorptiometry while osteopenia is defined as BMD between 1.0 and 2.5 SD below the young adult mean [8]. As bone density varies with age, Z-score is used in the pediatric population and not the T-score, which is usually used in adults and the Z scores of -2 SD define as osteoporosis [9].

SUBJECTS AND METHODS

This cross-section study was conducted on 60 children to determine the extent of osteoporosis in JIA. 30 patients diagnosed with JIA according to ILAR classification of JIA [10] and 30 crossed matched normal child as control.

They were attending the Outpatient Clinics of Pediatric and Rheumatology Departments, Al-Azhar

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University Hospital-Assuit through the period from February 2019 to December 2019.

Inclusion criteria:

Any child aged between 1 year and less than16 years old who was diagnosed with JIA was included in the study.

Exclusion criteria:

Age less than 1 year or more than 16 years, metabolic bone diseases, parathyroid gland dysfunction, thyroid gland dysfunction, chronic renal failure, drugs inducing osteopenia and obese children.

Investigatory workup:

All children were subjected to full history taking and clinical examination. After a mid-night fasting, all individuals were assessed by complete blood count (CBC), renal function, liver functions (aspartate transferase (AST), alanine transferase (ALT), serum alkaline phosphatase, C- reactive protein (CRP), anti-nuclear antibody (ANA), rheumatoid factor (RF) and erythrocyte sedimentation rate (ESR). Plain x-ray on both hands (postero-anterior view) and on both knees on standing position (lateral and antero-posterior view). X-ray results were assessed for the presence of bone erosion, joint space narrowing or justa-articular osteopenia. DEXA scan was done to all children (DEXA scan lunar DPX-NT 2013, General Electric, USA) to assess BMD at distal end of the radius, lumbar spine and neck of the femur [(11)].

Ethical and patient approval:

An approval of the study was obtained from Al-Azhar University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation.

Statistical analysis

The collected data were revised, organized, tabulated and statistically analyzed using statistical package for social sciences (SPSS) version 23.0 for windows. Data were presented as the mean ± standard deviation (SD), frequency, and percentage. Categorical variables were compared using the chi-square ($\chi 2$) and Fisher's exact tests.

Continuous normally distributed variables were compared using the Student's t test (two-tailed). Mann-Whitney U test was used for comparison of nonparametric continuous variables. The level of significance was set at P value ≤ 0.05.

RESULTS

Table (1): Baseline characteristics among patients with JIA versus controls

Parameters:	(Patients N = 30) Mean ± SD	Control (n = 30) Mean ± SD	P-value
Age(years)	11.47 ± 2.5	11.88 ± 2.2	0.142
Male	18(60%)	14(46.7%)	0.21
Female	12(40%)	16(53%)	
ALT(U/L)	20.45 ± 4.67	17.9 ± 4.44	0.32
AST(U/L)	21.56 ± 5.59	21.32 ± 5.77	0.75
Total bilirubin (mg/dl)	0.75 ± 0.17	0.66 ± 0.15	0.17
Direct bilirubin (mg/dl)	0.20 ± 0.05	0.19 ± 0.05	0.67
Albumin (g/dl)	3.95 ± 0.39	4.03 ± 0.48	0.38
ALP (IU/L)	85.77 ± 12.55	78.47 ± 14.23	0.12
Creatinine (mg/dl)	0.77 ± 0.21	0.78 ± 0.23	0.81
ESR(mm ^{h})	47.3 ± 5.42	5.27 ± 0.83	0.001
WBCs (10^3/mm^3)	7.41 ± 1.75	7.9 ± 1.65	0.16
HB(g/dl)	12.74 ± 0.34	12.89 ± 1.48	0.454
Platelets (10^3/mm^3)	254.83 ± 61.95	243.6 ± 68.34	0.072
Weight (kg)	32.7 ± 1.1	43.9 ± 8.3	0.015
Height (cm)	133 ± 13.7	146.5 ± 14.3	0.012
Duration of the disease (years)	5.1 ± 1.76	0	
BMI	18 ± 3.4	20.4 ± 2.6	0.046
< 5 percentile (stunted)	5	3	
≥5-85 percentile (normal)	20	22	
>85-≤95percentile (overweight)	3	2	
>95 percentile (obese)	2	3	

P value ≤ 0.05: significant

Table (1) shows a statistically significant difference between patients and control group as regard body weight, height, BMI and ESR. Patients were lighter, shorter, have lower BMI and higher ESR than controls.

Table (2): Pattern of different types of JIA and distribution of osteoporosis (DEXA findings)

Type of juvenile arthritis	Total N (%)	Osteoporosis N=24	Normal (N=6)
Oligo articular	12 (40%)	12 (50%)	0 (0%)
Systemic onset	8 (26.7%)	6 (25%)	2(33.3%)
Psoriatic	4 (13.3%)	4 (16.66%)	0 (0%)
Polyarticular RF +ve	4 (13.3%)	2 (8.33%)	2(33.3%)
Polyarticular RF -ve	2 (6.7%)	0 (0%)	2(33.3%)
Total	30 (100 %)	24 (80 %)	6 (20 %)

Table (2) shows the pattern of different types of JIA and distribution of osteoporosis (DEXA findings): The most prevalent type of JIA among our patients was oligoarticular type (40 %), all of them were osteoporotic and represent 50 % of all osteoporotic patients. Systemic onset JIA present among 26.7 % of patients 75 % of them were osteoporotic and represent 25 % of all osteoporotic patients. Psoriatic type of JIA present among 13.3 % of patients, all of them were osteoporotic. Polyarticular RF positive JIA also present among 13.3 % of patients, but only half of them were osteoporotic. Polyarticular RF negative JIA present among 6.7 % of patients and all of them have normal DEXA findings.

Table (3): Relation between X-ray and DEXA findings among patients with JIA

	X-ray findings	Normal DEXA N % = 6 (20%)	Osteoporosis DEXA N % = 24 (80%)	P-value
X-ray Hands	Periarticular osteopenia			
	Positive N (%)	0 (0%)	10 (41.7%)	0.045
	Negative N (%)	6 (100%)	14 (58.3%)	
	Erosion			
	Positive N (%	0 (0%)	8 (33.3%)	0.026
	Negative N (%)	6 (100%)	16 (66.7%)	
	Space narrowing			
	Positive N (%	2 (33.3%)	8 (33.3%)	0.67
	Negative N (%)	4 (66.7%)	16 (66.7%)	
X-ray Knee	periarticular osteopenia			
	Positive N (%)	0 (0%)	10 (41.7%)	0.045
	Negative N (%)	6 (100%)	14 (58.3%)	
	Erosion			
	Positive N (%	0 (0%)	4 (16.7%)	0.038
	Negative N (%)	6 (100%)	20 (83.3%)	
	Space narrowing			
	Positive N (%	2 (33.3%)	4 (16.7%)	0.034
	Negative N (%)	4 (66.7%)	20 (83.3%)	

P value ≤ 0.05: significant

This table (3) shows periarticular osteopenia, narrowing of joint space and erosion were the most common abnormality in x ray. Among 24 (80%) of children with JIA who had osteoporosis, 10 children with JIA (41.7%) had periarticular osteopenia in x-ray hand and knee. Erosions were present among 8 patients (33.3%) and 4 patients (16.7%) in x-ray hand and x-ray knee respectively. Space narrowing was found in 8 patients (33.3%) and 4 patients (16.7%) in x-ray hand and x-ray knee respectively. These results indicated that x-ray was not sensitive tool for diagnosis osteoporosis in children with JIA when was compared to DEXA.

DISCUSSION

As osteoporosis in children has a considerable burden of morbidity. Symptomatic osteoporosis in children may lead to recurrent low impact fractures or moderate to severe backache [(3)]. Low BMD is expected among children with chronic connective tissue diseases [(6)]. In the present study, we found that the majority of children with JIA [24 (80%)] were osteoporotic compared to control group [4 (13.3%)]. These results are consistent with a study by **Dey *et al.*** [(11)] who showed significantly lower level of BMD in children with JIA as compared to controls. In our study, we found a significant relation between osteoporosis and duration of

disease where children with JIA with longer duration (5.1 ± 2.76 years) and lower BMI were more suffering from osteoporosis than children with JIA with shorter duration of the disease or higher BMI. This result is consistent with the study done by **Boman *et al.*** [12] and **Islam *et al.*** [13] who found that the duration of arthritis was positively correlated with low BMD. On the other hand, **Dey *et al.*** [11] found that disease duration had no significant correlation with BMD of the patients.

This study showed that a significant relation between BMI and osteoporosis in our children with JIA. This result agrees with **Dey *et al.*** [11] who found that BMD is significantly lower in patients compared to controls.

Our results showed that all children with oligoarticular type JIA (50%) were osteoporotic, while osteoporosis was found in 6 (25%) patients with systemic onset type. All patients with psoriatic type (16.66%) were osteoporotic, half of the polyarticular RF +ve type (13.3%) were osteoporotic and patients with polyarticular RF -ve type (33.3%) were osteoporotic. These results are consistent with the study done by **Gunhild *et al.*** [14] and **Islam *et al.*** [13] in which osteoporosis was more common in oligoarticular type of JIA. On the other hand, this result disagrees with a study by **El Badri *et al.*** [15] who found that osteoporosis occurs in all of the JIA forms, most typically in systemic and polyarticular forms of disease with a significant relationship between bone loss and the systemic subtype of JIA.

As regards hand and knee x-ray findings, this study showed that children with JIA had periarticular osteopenia, narrowing of joint space and erosion compared to control group.

Limitation of the study: This study had some limitations as small numbers of the studied groups and the effect of activity of JIA on BMD had not be evaluated. Another limitation of our study was lack of evaluation of bone markers of osteoporosis (markers of bone turnover and bone formation).

CONCLUSION

Results obtained from this study suggest that osteoporosis was a frequent complication of JIA. JIA patients are likely to have low BMD. Children with JIA who have oligoarticular and systemic onset of JIA patients are more susceptible to low BMD. In addition, this study indicated that the duration of disease and BMI were important factors in development of low BMD in patients with JIA. These results should alert clinicians to the potentially high risk of development of osteoporosis later in children with JIA.

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