Assessment of Bone Density in Late Childhood Patients with Beta Thalassemia Major

Ahmed M Ali[1], Mohamed El Kalioby[2], Abdelmoneim Khashana[2], Marwa Azab Azab[3], Samar M. Elfiky[2], Hesham El Sayed[2].

1. Pediatrician, Ministry of Health, Ismailia, Egypt.
2. Pediatrics Department, Faculty of Medicine, Suez Canal University, Ismailia, 41522, Egypt.
3. Radiology Department, Faculty of Medicine, Suez Canal University, Ismailia, 41522, Egypt.

Abstract

Background: Chronic hemoglobinopathies like thalassemia are associated with many osteopathies like osteoporosis. Aim: The aim of this study was to evaluate the bone mineral density (BMD) in children with thalassemia major. Patients and Methods: Eighty children with beta thalassemia who also had low bone mineral density (BMD) and low serum zinc were included in a cross sectional study. At the conclusion of the study, BMD and serum zinc levels were evaluated. Dual-energy X-ray absorptiometry (DXA) scan was used to assess BMD. Result: A total of eighty β thalassemia major patients 41 (51.3%) male and 39(48.7%) female within the age range between 6-12years old with mean age 8.3±2.11 years contribute to the study. Linear regression analysis of variables that were independently associated with BMD-z score to evaluate the predictivity of these variables linear regression analysis illustrates that serum zinc and duration of chelation therapy could be a predictor for low BMD in thalassemic children. Conclusion: In children with Beta-thalassemia, low serum zinc may be used as a predictor of low BMD.

KeyWords: Thalassemia, bone mineral density.

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Introduction:

Through the use of chelating treatment and improved transfusion protocols, the management of patients with thalassemia has significantly improved during the past few decades [1]. The life expectancy and standard of living of these patients have significantly improved. It has been noted that this hemoglobinopathy is linked to a number of bone disorders, including pathologic fractures, osteopenia, and osteoporosis, as well as deformities, bone pains, delayed bone age, growth failure, rickets, scoliosis, and spinal deformities. High-dose iron chelating therapy with desferrioxamine may exacerbate osteopenia and osteoporosis in addition to the disease process itself [2,3].

For these patients, osteoporosis is a major cause of morbidity [4]. Low bone mass and disturbance of bone architecture are its defining traits, which lead to decreased bone strength and an elevated risk of fractures [5]. Although there are other methods for calculating the amount of total bone mass and the degree of osteoporosis, Dual Energy X-Ray Absorptiometry (DEXA) of the lumbar spine, femoral neck, and distal radius is regarded as a particularly accurate and noninvasive method [6].

Aim of the Study

The aim of this study was to evaluate the bone mineral density (BMD) in children with thalassemia major.

Patient and Methods:

This cross sectional was conducted at pediatric haematology clinic and diagnostic radiology departments in Suez Canal University Hospital, Ismailia, Egypt. This study enrolled eighty beta-thalassemia major patients attending to Suez Canal University hospital hematology outpatient clinic. The study included children 6 to 12 years of age with Beta thalassemia major. Bone marrow transplant recipient, or currently prescribed treatment for low bone mass other than calcium or vitamin D, or currently participating in another trial with a medication known to affect bone mineral density, and with chronic use of systemic corticosteroids were excluded from the study.

Methods of the study:

Statistical analysis

Data entry and statistical analyses were conducted using IBM SPSS STATISTICS version 22. Summary statistics were then computed, including means, SDs, and 95% CIs for all the variables in each group. Data throughout the thesis are

reported as means& SDs unless stated otherwise.

Results:

A total of eighty β thalassemia major patients 41 (51.3%) male and 39(48.7%) female within the age range between 6-12years old with mean age 8.3±2.11 years contribute to the study.

Table (3): Frequency of residence, gender and age in the intervention and non-intervention groups:

	N=80	
	N	%
Urban	31	38.75%
Rural	49	61.25%
Male	41	51.25%
Female	39	48.75%
Serum zinc ≤70(µg/dl)	38	47.5%
Age(year)		
(mean ±SD)	8.3±2.11	

Table (4) illustrates initial analysis that showed anthropometric measures, plasma zinc, and bone mineral density- Z score within the study patients.

Table (4) Baseline data for patient characteristics including anthropometric measures and biochemical profiles measures in the study patients.

Variable	Intervention group
Hight	124.13±12.36
Weight	26.8±7.01
BMI	17.01±1.51
Hb(gm/dl)	7.32±0.47
Serum ferritin	1753±278.08
(ng/ml)	
Duration of chelation therapy /years	5.1±1.9
Plasma zinc (µg/dl)	69.35±10.24
BMD-z score	-2.02± -0.57

Table 5 illustrates linear regression analysis of variables that were independently associated with BMD-z score to evaluate the predictivity of these variables linear regression analysis illustrates that serum zinc and duration of chelation therapy could be a predictor for low BMD in thalassemic children.

Table (7) Linear regression analysis for BMD post intervention (dependent variable) and (explantoryvarables) including serum zinc, ferritin, Hb, age, duration of chelation therapy:

Model	Variables	B	S.E	Beta	Sig	t	95%CI for B	
							Lower bound	Upper bound
1	Hb	0.03	0.15	0.021	0.8	0.19	-0.26	0.32
	Ferritin	$9.6*10^{-5}$	0.001	0.04	0.69	-0.39	-0.01	0.001
	Duration of chelation therapy	-0.2	0.09	-0.59	**0.03***	-2.19	-0.38	-.02
	Age	0.11	0.008	0.37	**0.2**	1.37	-0.05	0.27
	Serum zinc end	0.01	0.006	0.26	**0.02***	4.64	0.003	0.025
Constant		-3.04	1.33	-	0.02	-2.28	-5.69	-0.38

*Statistical significance at 0.05 level

Discussion:

Osteopenia or osteoporosis has been identified as a major source of morbidity in patients with thalassemia major over the past ten years and has been documented in roughly 40–50% of well-treated individuals [7]. The enlargement of bone marrow cavities and the reduction of trabecular bone volume, which results in decreased bone tissue and osteoporosis, are caused by enhanced marrow erythropoiesis and widespread iron deposition in thalassemic individuals . Chelation is a significant risk factor for osteoporosis in these individuals as high dosage desferrioxamine treatment lowers collagen production, increases osteoblast programmed cell death, and inhibits differentiation and proliferation of bone-forming cells. Chelation also causes a shortage in vitamins and minerals including zinc and vitamin D, which worsens the condition of the bones [8]. Bone disease is also influenced by the presence of various endocrinopathies such as hypogonadism, hypothyroidism, hypoparathyroidism, diabetes mellitus, and hypoparathyroidism.

The lumbar spine's BMD was significantly lower in the current study, which is consistent with earlier research that suggested this region was more adversely affected in thalassemia patients than the other BMD measurement locations [9].

In this study, patients had low mean weights and body mass indices. Chronic disease and endocrine alterations brought on by iron excess can be used to explain these changes.

Nearly all of the thalassemia cases in the current investigation had vitamin D insufficiency. Nutritional deficiencies and improper vitamin D hydroxylation in the liver as a result of hemochromatosis are the main contributors to vitamin D insufficiency in thalassemic individuals.

However, there was no discernible distinction in vitamin D levels between the case and control groups. This might be because vitamin D insufficiency is so widespread among India's population.

In another study, there was a statistically significant difference in bone mineral density between cases and controls at the lumbar spine (P = 0.013), but not at the distal radius or neck of the femur (P = 0.933). It's possible that if the control population had normal serum vitamin D levels, the disparities in the BMD of cases and controls would have been more obvious [10].

Age and bone mineral density revealed a negative connection at all the sites, however it was not statistically significant. This shows that BMD declines with age, as was previously seen in a study of Indian children with thalassemia between the ages of 10 and 25 [11]. BMD and vitamin D levels showed a favorable association as well, however it was not statistically significant. Similar to this, all three sites showed a positive connection between calcium levels and BMD, however only the neck of the femur showed a statistically significant difference.

Starting in adolescence, it was advises these patients to get annual BMD evaluations. In many undeveloped and underdeveloped countries, DEXA's accessibility and pricing are significant obstacles [12]. This study found that thalassemic children frequently have poor BMD. Low BMD may be predicted by low serum calcium, especially in groups with a high incidence of hypovitaminosis D. Therefore, blood calcium and vitamin D levels in thalassemics must be regularly checked in areas where DEXA is not widely available, especially beyond the age of 10, to assess bone health.

Conclusion:

In children with Beta-thalassemia, low serum zinc may be used as a predictor of low BMD.

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