Bone involvement and intervertebral disc calcifications in β-thalassemic patients: a retrospective study

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BACKGROUND

Beta-thalassemias are a group of hereditary blood disorders due to alterations in the synthesis of the β chains of hemoglobin. They have variable phenotypes from severe anemia to asymptomatic condition [1]. The annual incidence of symptomatic individuals is estimated at 1 in 100,000 throughout the world and 1 in 10,000 people in Europe [2]. Bone involvement in patients with β-thalassemia is well known [1,3-8], but only few studies have analyzed bone microarchitecture [4] and the prevalence of intervertebral disc (IVD) alterations in these patients [9-10]. The aim of our study was to evaluate the vertebral bone geometry and quality in a group of patients with β-thalassemia; moreover, we evaluated the involvement of IVD in terms of radiographic structural changes.

METHODS

Our retrospective case-control study was conducted in adults with β-thalassemia (aged 18-50 years). Patients were divided, according with the ISCD, into 2 groups: subjects with BMD Zs ≤-2.0, below the expected range for age, and subjects with BMD Zs >-2.0, within the expected range for age. Assessment of proximal femur geometry was performed using the Hip Structural Analysis (HSA), providing the following parameters: Hip Axis Length (HAL), Femoral Strength Index (FSI), Cross-Sectional Moment of Inertia (CSMI), Cross-Sectional Area (CSA), Section Modulus (Z), and buckling ratio (BR). Assessment of bone quality was performed using the Trabecular Bone Score (TBS), stratifying subjects into 3 groups: with abnormal (TBS ≤1.200), partially altered (TBS >1.200 and <1.350), and normal (TBS ≥1.350) trabecular microarchitecture. Finally, we evaluated the radiological findings of intervertebral disc calcifications (IDCs) at the Vertebral Fracture Assessment (VFA).

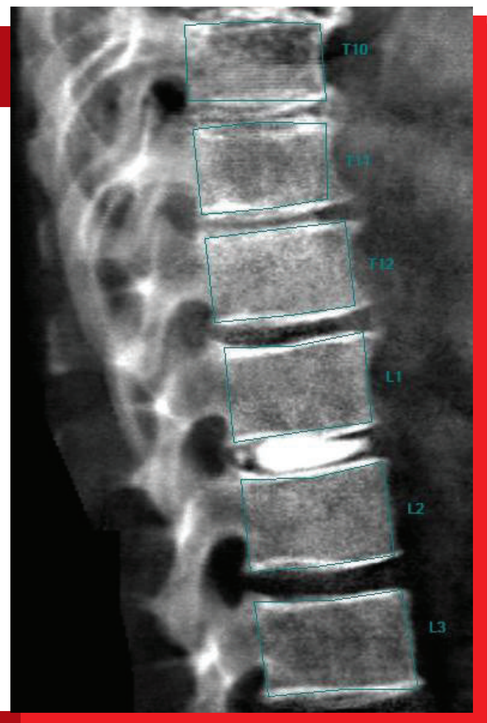

FIGURE 1. VFA IMAGE OF A PATIENT WITH A IDC.

RESULTS

We evaluated 49 patients with β-thalassemia, mean aged 35.2 ± 9.6 years, divided into two groups: 25 patients with Zs ≤-2.0 and 24 patients with Zs >-2.0. There was a statistically significant difference between groups in number of vertebral fragility fractures (p=0.0339) (Table 1). At the HSA we observed significant differences in FSI (1.29 ± 0.50 vs 1.64 ± 0.33) (Table 2). Furthermore, TBS of patients with Zs ≤-2.0 was significantly lower than individuals with Zs >-2.0 both as mean value (1.00 ± 0.10 vs. 1.14 ± 0.14; p=0.0006) and as categorized value (p=0.0061) (Table 3). Finally, we evidenced in 7 patients (15.56 %) the presence of at least one IDC (Figure 1).

Table 1. Differences between subjects with BMD Zs ≤-2.0, below the expected range for age, and subjects with BMD Zs >-2.0, within the expected range for age.

	Total (n=49)	Subjects with BMD Zs ≤-2.0 (n=25)	Subjects with BMD Zs >-2.0 (n=24)	P values
Age (means ± SD)	35.16 ± 9.59	37.28 ± 7.97	32.96 ± 10.75	0.0269*
BMI (means ± SD)	23.39 ± 3.30	23.65 ± 3.29	23.11 ± 3.41	0.2620**
Vertebral Fragility Fractures				0.0339**
0 (n,%)	36 (80.00)	16 (64.00)	20 (83.33)	
1 (n,%)	7 (15.57)	3 (12.00)	4 (16.67)	
≥2 (n,%)	6 (13.33)	6 (24.00)	0 (0.00)	
Intervertebral disc calcifications (n,%)	7 (15.56)	3 (12.00)	4 (16.67)	0.2390**
TBLH BMD (means ± SD)	0.939 ± 0.862	0.892 ± 0.841	0.985 ± 0.060	<0.0001**
TBLH Ts (means ± SD)	-1.53 ± 0.83	-2.15 ± 0.54	-0.98 ± 0.63	<0.0001**
TBLH Zs (means ± SD)	-1.33 ± 0.82	-1.94 ± 0.60	-0.77 ± 0.55	<0.0001**
LS BMD (means ± SD)	0.928 ± 0.128	0.850 ± 0.113	1.010 ± 0.086	<0.0001**
LS Ts (means ± SD)	-2.06 ± 1.18	-2.79 ± 0.76	-1.30 ± 1.07	<0.0001**
LS Zs (means ± SD)	-1.91 ± 0.98	-2.58 ± 0.75	-1.21 ± 0.65	<0.0001**
FN BMD (means ± SD)	0.792 ± 0.122	0.720 ± 0.114	0.870 ± 0.076	<0.0001**
FN Ts (means ± SD)	-1.73 ± 0.97	-2.37 ± 0.83	-1.06 ± 0.58	<0.0001**
FN Zs (means ± SD)	-1.52 ± 0.96	-2.11 ± 0.76	-0.90 ± 0.73	<0.0001**

Values are expressed as means ± standard deviations. Abbreviations: BMI: Body Mass Index; TBLH: Total Body Less Head; LS: Lumbar Spine; FN: Femoral Neck. *= Wilcoxon signed-rank sum, **= MANOVA.

Table 2. Differences in Hip Structural Analysis parameters between subjects with BMD Zs ≤-2.0, below the expected range for age, and subjects with BMD Zs >-2.0, within the expected range for age.

	Total (n=49)	Subjects with BMD Zs ≤-2.0 (n=25)	Subjects with BMD Zs >-2.0 (n=24)	P values
HAL (mm)	103.86 ± 8.38	104.70 ± 9.59	102.98 ± 7.00	0.2118*
FSI	1.46 ± 0.46	1.29 ± 0.50	1.64 ± 0.33	0.0068*
CSMI (mm^4)	9355.35 ± 3341.06	8892.44 ± 3528.19	9837.54 ± 3135.47	0.1503*
CSA (mm^2)	126.94 ± 25.17	116.28 ± 27.07	138.04 ± 17.47	0.0041*
Z (mm^3)	548.72 ± 148.77	514.52 ± 146.43	584.34 ± 134.38	0.0711*
BR	9.55 ± 7.28	9.39 ± 5.73	9.71 ± 8.73	0.2876*

Values are expressed as means ± standard deviations. Abbreviations: HAL: Hip Axis Length; FSI: Femoral Strenght Index; CSMI: Cross Sectional Moment of Inertia; CSA: Cross-Sectional Area; Z: Section Modulus;
BR: Buckling Ratio. *= MANOVA.

Table 3. Differences of trabecular bone score (TBS) between subjects with BMD Zs ≤-2.0, below the expected range for age, and subjects with BMD Zs >-2.0, within the expected range for age.

	Total (n=49)	Subjects with BMD Zs ≤-2.0 (n=25)	Subjects with BMD Zs >-2.0 (n=24)	P values
TBS	1.07 ± 0.13	1.00 ± 0.10	1.14 ± 0.14	0.0006*
TBS cat				0.0061*
TBS ≤ 1.2 (n,%)	41 (83.67)	25 (100.00)	16 (66.67)	
TBS > 1.2 e < 1.35 (n,%)	6 (13.33)	0 (0.00)	6 (25.00)	
TBS ≥ 1.35 (n,%)	2 (4.44)	0 (0.00)	2 (8.33)	

Values are expressed as means ± standard deviations. Abbreviations: cat: categorical. *= MANOVA.

CONCLUSIONS

Our results showed that β-thalassemia is characterized not only by a reduction in BMD, but also by a bone geometry and bone microarchitecture deterioration, highlighting that TBS should be included in the assessment of these subjects, to provide adjunctive information for proper diagnosis, management and prevention of fragility fractures; furthermore, presence of IDCs should be better investigated to understand their pathogenic role in skeletal disorder in thalassemic patients.

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