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Investigation of Relationship Between Lumbar Modic Changes and Serum Vitamin D Concentrations

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Abstract

Introduction: There is limited and inconsistent data on the relationship between vitamin D deficiency and Modic changes (MCs). Also, which type of MCs is associated with vitamin D is not clear. Vitamin D has anti-inflammatory effects, while type 1 MCs has inflammatory nature. Accordingly, patients with type 1 may have lower vitamin D levels than those with type 2 MCs. This study aimed to compare type 1 and type 2 MCs for serum vitamin D concentrations.

Materials and Methods: Between May 2019 and July 2020, a total of 53 patients with type 1 or type 2 MCs were included in this study. Patients' demographics were recorded, and back pain severity was assessed by using visual analog scale. Serum levels of vitamin D were measured as total 25-hydroxy vitamin D. Accordingly, serum levels of vitamin D (µg/L) are graded as deficient (<20), insufficient (20-30), and sufficient (30-80).

Results: Type 1 MCs (n=26) and type 2 MCs (n=27) groups were similar in age (p=0.199), gender, BMI, work status, pain duration, vitamin D concentration, degree of vitamin D deficiency (p=0.773), and spinal levels. Type 1 MCs patients had more painful low back than type 2 MCs patients.

Conclusion: Type 1 MCs are similar to type 2 MCs for serum vitamin D concentration. The more painful low back of type 1 MCs may be related to its inflammatory nature, but may not be associated with vitamin D insufficiency.

Key words: Vitamin D; lumbar osteoarthritis; back pain; inflammation.

Introduction

Vitamin D is a steroidal lipid-soluble hormone, and has a great importance for human health because of its multiple and critical functions in the body. Its role in the calcium metabolism and its deficiency in skeletal diseases like osteomalacia and osteoporosis are well known (1). On the other hand, nowadays anti-inflammatory and immunomodulatory functions of vitamin D are better understood (3,4), and the significance of vitamin D is beyond the calcium metabolism and skeletal diseases. Since vitamin D receptors are found in all parts of the body, and vitamin D insuficiency is related to many disorders such as inflammatory, rheumatic, and autoimmune diseases, hypertension, diabetes mellitus, and cancer (1,2). It has been suggested that these skeletal/extraskeletal and multiple/diverse outcomes of vitamin D deficiency are related to decreased anti-inflammatory and immunomodulatory effects of vitamin D (1-4). Modic changes (MCs) are seen as different signal intensities on magnetic resonance imaging (MRI), reflecting different histological tissues in vertebral endplate. Accordingly, type 1 MCs are seen as hypointense on the T1 and hyperintense on the T2, type 2 MCs are seen as hyperintense on the both T1 and T2, and type 3 MCs are seen as hypointense on the both T1 and T2 MRI images. Histologically, types 1, 2, and 3 MCs reflect bone marrow edema and inflammation, bone marrow fat, and bone sclerosis, respectively (5). The etiopathogenesis underlying MCs is not clear, and they are potentially interconvertible (6). However, it has been postulated that injury, inflammation, and infection-related reaction are involved to type 1 MCs, but increased mechanical loading and systemic factors are mechanisms for type 2 MCs (7-9). No standardized therapeutic approach, but non-surgical therapies are preferred, and personalized options required for patients with MCs (6,8). Some previous studies have addressed the possible link between MCs and vitamin D deficiency (10,11). However, there is low and limited literature with inconsistent results on this

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topic, and which type of MCs is more associated with vitamin D deficiency has not been adequately addressed. The anti-inflammatory and immunomodulatory features of vitamin D (3,4,12), and the inflammatory nature and possible post-infectious immune reaction in type 1 MCs (5-9) suggest that vitamin D insufficiency may be related to the development of type 1 MCs. Accordingly, we hypothesized that patients with type 1 MCs may more related to serum levels of vitamin D than type 2 MCs. To test this hypothesis, we aimed to compare type 1 and type 2 MCs for serum vitamin D concentrations.

Materials and Methods

This comparative study was conducted prospectively between May 2019 and July 2020. Totally, 53 patients with type 1 (n=26) or type 2 (n=27) MCs were included in the present study. Inclusion criteria were female or male patients with MCs, age between 18 and 65 years, and given written informed consent for participation. On the other hand, exclusion criteria were presence of spinal structural abnormalities such as fracture, scoliosis, vertebral fusion or deformity, inflammatory rheumatic diseases such as ankylosing spondylitis and rheumatoid arthritis, lactation, pregnancy, extreme obesity (BMI≥40 kg/m²), and malignancy. In addition, patients with type 3 MCs, and patients having a combination of MCs' types were excluded. Serum vitamin D concentrations were measured by the Elecsys Vitamin D total III cobas® Roche. This assay is used for the in vitro quantitative measurement of total 25-hydroxy vitamin D in human fluids. The test is based on the competition principle, and includes three incubation reactions, and results are determined via curves. Accordingly, serum levels of vitamin D (μg/L) are graded as deficient (<20), insufficient (20-30), and sufficient (30-80). Patients' demographics were recorded, and low back pain severity was assessed by using 11-point visual analog scale. After laboratory measurements, the variables obtained from the groups were assessed and compared by using statistical analyses.

Table 1: Comparisons between the groups in terms of demographic characteristics.

	Type 1 MCs group (n=26)	Type 2 MCs group (n=27)	p
Age, years	43.08±9.63 (27-62)	46.52±9.61 (29-65)	0.199
Gender			
Female	17 (65.38%)	21 (77.78%)	0.372
Male	9 (34.62%)	6 (22.22%)	
Weight, kg	76.46±11.80 (55-100)	77.41±13.68 (54-115)	0.788
Height, m	1.67±0.07 (1.54-1.82)	1.66±0.09 (1.53-1.90)	0.394
BMI, kg/m²	27.24±4.12 (20.96-38.10)	28.06±3.16 (22.48-34.88)	0.418
Work status			
Housewife	16 (61.54%)	20 (74.08%)	0.593
Employee	8 (30.77%)	6 (22.22%)	
Not employee	2 (7.69%)	1 (3.70%)	

MCs: Modic changes; **BMI:** Body mass index; Values were given as mean±SD (min.-max.) or n (%).

Table 2: Comparisons between the groups in terms of pain duration, degree of vitamin D deficiency, and MCs levels.

	Type 1 MCs group (n=26)	Type 2 MCs group (n=27)	p
Pain duration, years	8.12±5.87 (1-25)	8.00±6.74 (1-30)	0.947
Vitamin D			
Deficient, <20 μg/L	16 (61.54%)	19 (70.37%)	0.773
Insufficient, <30 μg/L	7 (26.92%)	6 (22.22%)	
Sufficient, >30 μg/L	3 (11.54%)	2 (7.41%)	
Spinal levels of MCs			
L5-S1	19 (73.08%)	19 (70.37%)	
L4-L5	5 (19.23%)	7 (25.93%)	0.726
L3-L4	1 (3.85%)	1 (3.70%)	
L2-L3	1 (3.85%)	0 (0.0%)	

MCs: Modic changes; Values were given as mean±SD (min.-max.) or n (%).

Ethical consent: The ethical approval was received retrospectively. Permission for the study was obtained from Harran University Faculty of Medicine Clinical Research Ethics Committee with numbered HRÜ/23.21.24 dated 13/11/2023. Written informed consent was obtained from the patients, and the study was performed following the ethical standards of the Declaration of Helsinki.

Statistical analysis: Statistical analyzes were performed with IBM SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Using the Kolmogorov-Smirnov test, it was addressed whether continuous variables have normal distribution. Since the continuous variables exhibited normal distribution, the parametric tests were considered for their analyses. Thus, the Student t-test was used to compare the groups for continuous variables. The Fisher's Exact test for gender, and the Chi-square test for other categorical variables were applied. The Pearson Correlation test was used to evaluate the significance of Correlations between continious parameters. A p-value <0.05 was considered statistically significant level.

Results

Table 1 presents comparisons between the groups in terms of demographic characteristics. The two groups were statistically similar in age (p=0.199), gender (p=0.372), BMI (p=0.418), and work status (p=0.593) (Table 1). Table 2 presents comparisons between the groups in terms of pain duration (years), degree of vitamin D deficiency, and spinal levels of MCs. The two groups were statistically similar in terms of these parameters (p=0.947, p=0.773, and p=0.726, respectively) (Table 2).

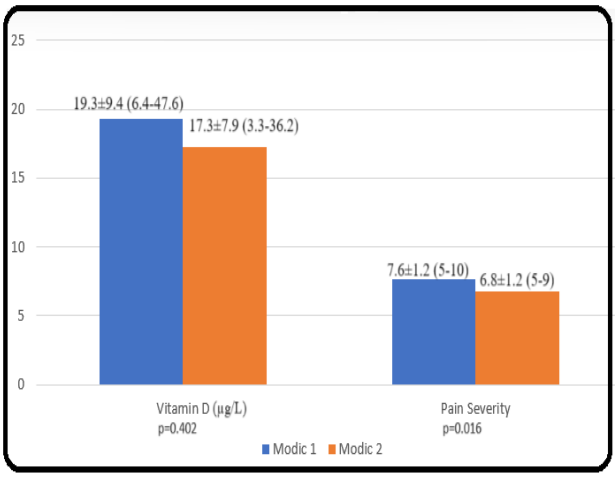

Figure 1: Comparisons between the groups in terms of vitamin D and pain severity.

The values were given as mean±SD (min.-max.). Pain severity was measured by visual analogue scale (0-10).

Figure 1 presents the comparisons between the groups in terms of pain severity and vitamin D deficiency. As result, the groups were significantly different from each other in pain severity (p=0.016), however, they showed statistical similarity in terms of vitamin D deficiency (p=0.402). That is, patients with type 1 MCs had significantly higher scores of low back pain than those with type 2 MCs [7.62±1.17 (5-10) versus 6.81±1.18 (5-9)] (Figure 1). Table 3 presents statistical correlations of vitamin D level with age, BMI, Pain duration, and pain severity considering type I (n=26), type 2 (n=27), and type I+type 2 (n=53) MCs patients separately. However the correlations were not statistically significant (for all, p>0.05; Table 3).

Table 3: Correlations of vitamin D with other parameters in MCs patients.

		Age	BMI	Pain duration	Pain severity
Type I MCs (n=26)	r	-0.392	0.003	-0.025	0.256
	p	0.048	0.987	0.904	0.206
Type II MCs (n=27)	r	0.146	0.334	-0.170	-0.171
	p	0.468	0.092	0.397	0.393
Types I+II MCs (n=53)	r	-0.159	0.119	-0.094	0.095
	p	0.257	0.395	0.501	0.500

BMI: Body mass index; **MCs:** Modic changes.

Discussion

In this comparative study, demographic characteristics, serum vitamin D concentrations, and pain features were investigated in type 1 and type 2 MCs patients. The results of statistical comparisons demonstrated that the groups were similar in terms of investigated parameters, except pain severity. Accordingly, patients having type 1 MCs exhibited more severe pain than those with type 2 MCs. However, statistical correlations between the parameters were not significant. Thus, the results did not support the hypothesis postulated an association of vitamin D with type 1 MCs. Although serum vitamin D concentrations have been addressed in many medical conditions (1,2), previous studies investigated the association of this important vitamin with MCs are limited and have reached inconsistent results (10,11). Johansen et al. (10) have reported higher, while Mattam et al. (11) have found lower serum vitamin D concentrations in patients with MCs. In addition, it is not clear that which type of MCs is

more associated with vitamin D deficiency. While Johansen et al. (10) have not presented a detailed analysis on vitamin D status in the MCs' types, Mattam et al. (11) have found lower serum vitamin D levels with higher BMI values in patients with type 1 MCs. So, lower serum vitamin D levels of patients with type 1 MCs in the study by Mattam et al. (11) may be due to higher BMI values, because obesity is associated with low vitamin D levels (15). Considering the groups were similar for BMI in our study, it can be said that the results of the present study are not affected by obesity, and are more reliable in this respect. In line with this, we found that no significant correlation between vitamin D level and BMI in patients with MCs. Both vitamin D deficiency and MCs are related to low back pain (13,14). Recent evidence suggests that patients with type 1 MCs have more painful low back than those with type 2 MCs (14). In our study, despite type 1 MCs patients were similar to type 2 MCs patients in terms of serum vitamin D concentration, the severity of low back pain was higher in patients with type 1 MCs. These results and also the absence of significant correlation between vitamin D level and pain severity suggest that the more severe low back pain in patients with type 1 MCs is not associated with vitamin D insufficiency, but possibly is related to the inflammatory nature of type 1 MCs.

Study limitations: This study has several limitations. Firstly, it should be noted that the study has small samples. Secondly, the study was conducted at a single-center. Thirdly, considering that results may vary in different societies and geographies, generalizability may not be possible. Fourthly, the study nature does not allow to discuss a possible causal link between vitamin D deficiency and MCs. Lastly, duo to limited literature on the topic, a deep and satisfying discussion could not been revealed.

Conclusions

In conclusion, low back pain patients with type 1 MCs are similar to those with type 2 MCs in terms of serum vitamin D concentration. However, type 1 MCs patients have more painful low back than type 2 MCs patients, and this may be associated with the inflammatory nature of type 1 MCs, but may not be related to vitamin D insufficiency.

Ethical approval: The ethical approval was received retrospectively. Permission for the study was obtained from Harran University Faculty of Medicine Clinical Research Ethics Committee with numbered HRÜ/23.21.24 dated 13/11/2023.

Conflict of interest: There is no conflict of interest.

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