RESEARCH PAPER

Vitamin D deficiency and Tuberculosis in Basrah: The Effect of Anti-tuberculosis Drugs

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Abstract

Low vitamin D levels had been reported to be associated with a wide range of health problems, one of them is tuberculosis.

Aims To estimate vitamin D serum concentration among patients with tuberculosis and their matched controls at baseline, and for TB patients at 2 and 5 months after starting anti-tuberculosis treatment.

Methods: The study was carried out at the TB Center and College of Medicine in Basrah (Iraq), during the period from September 2018 to June 2019. Participants were newly diagnosed tuberculosis patients, and their matched apparently healthy controls. Total 25-hydroxy vitamin D in serum was estimated using chemiluminescent microparticle immunoassay. Calcium, phosphorus, alkaline phosphatase, parathyroid hormone, and others were also measured.

Results: There were no statistically significant difference in the mean levels of vitamin D between tuberculosis patients at baseline (n=56) and control subjects (n=57). The prevalence of vitamin D deficiency was high in patients and their controls at baseline where more than 80% of them had a vitamin D level below 20 ng/ml.

When patients were followed two months after starting anti-tuberculosis treatment, the mean serum vitamin D level was significantly lower than that at baseline. Despite the widespread vitamin D deficiency among TB patients, all smear-positive pulmonary TB patients, except 3, had sputum conversion after 2 months of treatment.

Conclusion: The prevalence of vitamin D deficiency is high with no significant difference between tuberculosis patients at baseline and their matched normal controls. Vitamin D deficiency did not seem to affect the response of patients to anti-TB treatment.

Keywords: Vitamin D, tuberculosis, anti-tuberculosis drugs

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Introduction

Tuberculosis is a common health problem world-wide. About 50% of TB patients achieved cure after treatment, although they may develop moderate to severe impairment of pulmonary function.[1] The WHO estimated that Iraq is one of the seven high TB prevalent countries in the Eastern Mediterranean region, where it represents 3% of all TB cases in the region.[2] It may be triggered when the immune system is impaired many years following exposure to TB infection.[3]

Several studies had reported vitamin D deficiency as a risk factor for TB infection,[4-6]

and higher percentage of TB patients showed vitamin D deficiency compared with controls.[7-11]

Vitamin D is a fat-soluble vitamin, synthesized mainly in the skin after exposure to sunlight as vitamin D3.[12] There are two forms of vitamin D; vitamin D3 (cholecalciferol), and vitamin D2 (ergocalciferol). Two hydroxylation reactions are required to obtain the active form of vitamin D; 1, 25-dihydroxyvitamin D [Calcitriol].[13]

Vitamin D has a wide range of effects on cellular functions because of the presence of its receptors in most types of cells, such as immune and circulatory systems.[14, 15] It plays an important role in musculoskeletal system and mineral metabolism; maintaining calcium and phosphorus levels. Vitamin D exhibits other "non-classical" actions. An example of non-classical actions of vitamin D is its regulation of insulin secretion.[15]

Hypovitaminosis D is common in the Middle East and North Africa regions in spite of high sun exposure throughout the year.[14] Vitamins D deficiency is suspected in patients suffering from musculoskeletal manifestation such as myalgia, bone pain and generalized weakness.[16]

The present study is intended to estimate vitamin D serum concentration among TB patients and their matched controls at baseline, and to follow TB patients for 2 and 5 months after starting treatment regarding their response to treatment and vitamin D level.

Methods

A This study was carried out in the TB center and College of Medicine in Basrah (Iraq) during the period from September 2018 to June 2019. It was approved by the Ethical Committee of the College of Medicine and Basrah Health Directorate. The study was conducted on 56 newly diagnosed TB patients (pulmonary and extra-pulmonary; 24 males and 32 females), who gave their consent to participate in the study. Patients who were on vitamin D treatment prior to diagnosis, pregnant and breast feeding women, those with liver and kidney diseases, cancer, and patients on enzyme inducers were excluded. Fifty seven apparently healthy control subjects were also included in the study.

The diagnosis of pulmonary TB was confirmed by sputum smear microscopy (Acid Fast Bacilli), radiography and Xpert MTB/RIF test, in addition to clinical assessment by a specialist physician. While that of extra-pulmonary TB was done by histopathological examination of a specimen from the affected organ; in addition to magnetic resonance and radiographical imaging.

The patients received anti-TB treatment in two phases. In the first phase (the intensive phase) which lasted for two months, four drugs were administered in fixed combination doses. Four tablets were taken on empty stomach for each patient weighed > 50 kg; each one contained 75 mg INH, 150 mg rifampicin, 400 mg pyrazinamide and 275 mg ethambutol.

In the second phase (the continuation phase) lasted for four months; two anti-TB drugs in fixed combination doses (INH and rifampicin) were taken. Also four tablets for each patient weighed > 50 kg; each one contained 75 mg INH and 150 mg rifampicin. For patients with body weight 40 kg to less than 50 kg, three tablets were taken.

A questionnaire form was filled for each participant, containing information regarding age, gender, educational level, occupation, sun exposure, skin color, residency, social habits, smoking and others. In addition, body weight and

height were measured to calculate body mass index (WHO classification of BMI).[17]

Peripheral venous blood samples were collected from each participant, for measurement of serum vitamin D, hemoglobin, ESR, and serum calcium, phosphorus, alkaline phosphatase and parathyroid hormone. Vitamin D was measured by chemiluminescent microparticle immunoassay (CMIA). In the present study, the metabolically stable form of vitamin D; 25(OH)D was measured. Two cut-off points were used 20 ng/ml and 10 ng/ml to diagnose deficiency. This was compared, at baseline, with matched apparently healthy controls (Vitamin D level in controls was measured, in addition to CMIA, by enzyme-linked fluorescent assay to look for the correlation between the two methods and is already published - Yaqoob et al, 2019.[18] Patients were followed up two and five months after starting anti-TB treatment regarding their vitamin D level and other parameters measured at time of diagnosis to evaluate response to anti-TB drugs and their effect on vitamin D level.

The rest of biochemical analytes including calcium, phosphorus, and alkaline phosphatase in serum were analyzed by Cobas integra 400 plus autoanalyzer (Roche, Germany). Serum parathyroid hormone was measured using Cobas E411 ECLIA immune-analyzer at the main laboratory of Basrah Teaching Hospital.

Statistical Package for Social Sciences (SPSS), version 20 was used for statistical analysis; p value < 0.05 was considered statistically significant. Paired sample t-test, Fisher's exact test and Binary logistic regression analysis were used as appropriate.

Results

Characteristics of TB patients recruited for the present study.

Fifty six TB patients were recruited for this study. Their age ranged from 8 to 68 years, with a mean of 34.7±16.6 years. 24 (42.9%) were males and 32 (57.1%) were females. Twenty seven (48.2%) of them had pulmonary TB (24 were sputum smear-positive and 3 were sputum smear-negative) and 29 (51.8%) had extra-pulmonary TB (mainly TB lymphadenitis). Twenty three of the 27 pulmonary TB patients had unilateral lesion on chest x-ray and only 4 patients had bilateral lesions, five of all pulmonary TB patients, had cavitation on chest x-ray and four of them had both cavitation and infiltration, while the remaining had infiltration only. Other characteristics were shown in (table 1).

Baseline measurement of vitamin D

Vitamin D serum level was measured in TB patients at baseline (before treatment with anti-TB drugs) and their matched controls using chemiluminescent microparticle immunoassay (CMIA) method. The mean level of vitamin D was 11.92±6.91 ng/ml for patients and 11.57±6.63 ng/ml for controls.

Categorization of vitamin D serum level into deficient, insufficient and sufficient categories

The majority of participants (more than 80%) had serum vitamin D levels within the deficient range when the cut-off point was taken below 20 ng/ml. Only two patients had vitamin D serum level more than 30 ng/ml. The percentages were reduced to 51.8% when the cut-off point for

deficiency was taken below 10 ng/ml, and the proportions of insufficient and sufficient categories increased considerably (Table 2).

TABLE 1: GENERAL CHARACTERISTICS OF TB PATIENTS RECRUITED FOR THE PRESENT STUDY.			
Characteristics		**TB patients (n=56)**	
Age (years)	Mean ±SD	34.7± 16.6	
	< 18	9 (16.1%)	
	18-65	44 (78.6%)	
	> 65	3 (5.4%)	
Gender	Males	24 (42.9%)	
	Females	32 (57.1%)	
BMI (Kg/m^2)	Mean ±SD	25.2±6.8	
	< 18.5	4 (7.1%)	
	18.5-24.9	26 (46.4%)	
	25-29.9	14 (25%)	
	≥ 30	12 (21.4%)	
Smoking	Adults male smokers	10 (17.9%)	
	Adults male non-smokers	6 (10.7%)	
Skin color	White	9 (16.1%)	
	Light brown	39 (69.6%)	
	Dark brown	8 (14.3%)	
Occupation	Indoor occupation	46 (82.1%)	
	Outdoor occupation	10 (17.9%)	
Residency	Urban	31 (55.4%)	
	Rural	25 (44.6%)	
Sun exposure	< 20 minutes/day	15 (26.8%)	
	20-60 minutes/day	16 (28.6%)	
	> 60 minutes/day	25 (44.6%)	
Educational level	Illiterate	12 (21.4%)	
	Primary	27 (48.2%)	
	Secondary	14 (25%)	
	University	3 (5.4%)	
TB type	Pulmonary	27 (48.2%)	
	Sputum smear +ve		24 (88.9%)
	Sputum smear -ve		3 (11.1%)
	Extra-pulmonary	29 (51.8%)	
Associated diseases	Yes	20 (35.7%)	
	Diabetes mellitus, Hypertention or both		14 (70%)
	Others		6 (30%)
	No	36 (64.3%)	
Radiographic findings (pulmonary)	Unilateral lesion	23 (85.2%)	
	Bilateral lesion	4 (14.8%)	

TABLE 2: CATEGORIZATION OF VITAMIN D SERUM LEVELS INTO DEFICIENT, INSUFFICIENT AND SUFFICIENT, WHEN THE CUT-OFF POINT FOR DEFICIENCY WAS TAKEN AS < 20 NG/ML OR <10 NG/ML.			
25(OH)D	**Method of assay**	**Cut-off point < 20 ng/ml**	**Cut-off point < 10 ng/ml**
Deficient < 20 ng/ml, <10 ng/ml	CMIA	49 (87.5%)	29 (51.8%)
Insufficient 20-30ng/ml, 10-20 ng/ml	CMIA	5 (8.9%)	20 (35.7%)
Sufficient > 30 ng/ml, >20 ng/ml	CMIA	2 (3.6%)	7 (12.5%)

Measurement of vitamin D serum level two months after starting anti-TB treatment: Comparison with baseline measurement of TB patients.

The mean level of vitamin D for 45 TB patients, followed two months after starting their anti-TB treatment, was significantly lower than their mean at baseline (before starting anti-TB treatment), by 18.3% (from 11.38±6.69 to 9.30±5.05, $P = 0.011$, n=45).

All sputum smear-positive pulmonary TB patients achieved sputum conversion at 2 months except three; one of them achieved sputum conversion at the third month of starting anti-TB treatment (The patient's vitamin D level at baseline was 8.7 ng/ml, while after two months, it increased to 19.4 ng/ml). For the second patient, vitamin D was 7 ng/ml at baseline, with no follow up measurement. The third patient did not achieve sputum conversion even at the fifth month after starting treatment (vitamin D level was 13.3 ng/ml at baseline and 3.8 ng/ml after two months).

Serum vitamin D levels two and five months after starting anti-TB treatment.

Only 25 patients of the original 56 recruited at baseline, could be followed after 5 months.

Comparison of the 25 patients at baseline, two and five months after starting anti-TB treatment, showed that the mean serum level of vitamin D was lower by 29.5% at 2 months, and 15.4% at five months after starting anti-TB treatment in comparison to their baseline values. The difference at five months was not statistically significant (p value= 0.084) when compared with baseline measurement. The means of vitamin D serum concentration were within the deficient range, when below 20 ng/ml cut-off point was considered (Table 3).

TABLE 3: MEASUREMENT OF VITAMIN D SERUM LEVEL IN TB PATIENTS BEFORE, TWO AND FIVE MONTHS AFTER STARTING ANTI-TB TREATMENT OF 25 PATIENTS.					
Method	**25(OH)D serum level (ng/ml)**				
	Before starting anti-TB treatment (n=25)	Two months after starting anti-TB treatment (n=25)		Five months after starting anti-TB treatment (n=25)	
	Conc.	Conc.	% reduction	Conc.	% reduction
CMIA	12.67 ±6.45	8.93 ±4.73**	29.5%	10.72 ±4.13	15.4%

Significant difference with respect to baseline:**P<0.01

Effect of two and five month - anti-TB treatment on vitamin D serum levels categorized into deficient, insufficient and sufficient ranges as compared with baseline levels.

Two months of anti-TB treatment increased the percentage of vitamin D deficient patients from 88.9% into more than 95%, with no patient having sufficient range of vitamin D, when the cut-off point for deficiency was taken as < 20 ng/ml (table 4). These proportions were reduced to 53.3% and 66.7% at baseline and after 2 months, when the cut-off point for deficiency was taken below 10 ng/ml. A follow up of 25 patients for five months after starting anti-TB treatment

showed that the majority of patients (96%) were still in the deficient range of serum vitamin D. This increase in the percentage of vitamin D deficient patients was not statistically significant compared with baseline level. At 5 months of treatment, the percentage of vitamin D deficient patients was reduced from 96% to 52% when the cut-off point for deficiency was taken below 10 ng/ml.

TABLE 4: CATEGORIZATION OF VITAMIN D SERUM LEVEL OF TB PATIENTS INTO DEFICIENT, INSUFFICIENT AND SUFFICIENT, TWO AND FIVE MONTHS AFTER STARTING TREATMENT IN COMPARISON WITH BASELINE MEASUREMENTS, WHEN THE CUT-OFF POINT FOR DEFICIENCY WAS TAKEN AS < 20 NG/ML.				
25(OH)D	**Method of assay**	**Number (% of total)**		
		TB patients at baseline (n=45)	**TB patients after 2 months (n=45)**	**TB patients after 5 months (n=25)**
Deficient < 20 ng/ml	CMIA	40 (88.9%)	43 (95.6%)	24 (96%)[#]
Insufficient 20-30 ng/ml	CMIA	3 (6.7%)	2 (4.4%)	1 (4%)[#]
Sufficient > 30 ng/ml	CMIA	2 (4.4%)	0	0[#]

The number at 5 months was compared with levels of same patients at baseline

Serum calcium, phosphorus, alkaline phosphatase and parathyroid hormone levels in TB patients measured at baseline, two and five months after starting anti-TB treatment.

There were no significant differences in the mean levels of the measured biochemical parameters in patients before starting anti-TB treatment and after two months of TB treatment except for parathyroid hormone where it significantly increased from a mean of 38.11 pg/L to 50.93 pg/L. All mean values were within normal ranges except alkaline phosphatase where the means at baseline, two and five months after starting anti-TB treatment were higher than the reported normal ranges. The mean levels of the measured biochemical parameters in the group of TB

patients that were followed for 5 months after starting anti-TB treatment showed a statistically significant decrease in phosphorus level and a significant increase in parathyroid hormone when compared with the levels of the same patients at baseline (Table 5).

TABLE 5: SERUM CALCIUM, PHOSPHORUS, ALKALINE PHOSPHATASE AND PARATHYROID HORMONE LEVELS IN TB PATIENTS MEASURED AT BASELINE, TWO AND FIVE MONTHS AFTER STARTING ANTI-TB TREATMENT.			
Parameters	**TB patients Before treatment (n=45)**	**TB patients two months after starting treatment (n=45)**	**TB patients five months after starting treatment (n=25)**
Calcium (Normal 8.4-11.2 mg/dL)	8.91±1.08 (n=28)	8.77±0.83 (n=28)	9.10±0.72 (n=23) #
Phosphorus (Normal 2.3-4.7 mg/dL)	3.86±1.02 (n=42)	4.07±1.57 (n=42)	3.50±0.89* (n=22) #
Alkaline Phosphatase (Normal 40 to 150 U/L)	197.71±139.14 (n=30)	197.78±160.14 (n=30)	206.44±146.1 (n=9) #
Parathyroid hormone (Normal 15-65 pg/L)	38.11±27.33 (n=40)	50.93±29.43** (n=40)	64.49±56.52** (n=22) #

Data are expressed as mean±SD and (number of patients).
The number at 5 months was compared with levels of same patients at baseline.
The mean levels of ALP in adults (after excluding those below the age of 18 years) were 162.61±63.33 U/L at baseline (n=23), and 146.78±41.44 U/L after 2 months (n=23).
Significant difference from same patients at baseline & after 2 and 5 months:** *P*<0.01.
Statistically significant with respect to baseline measurements:* *P*< 0.05.

Correlation between vitamin D serum level with each of serum calcium, phosphorus, alkaline phosphatase and parathyroid hormone among TB patients and controls.

The correlation between vitamin D serum concentration and serum levels of calcium, phosphorus and alkaline phosphatase at baseline was not statistically significant. Parathyroid hormone, on the other hand, showed a significant negative correlation with vitamin D serum concentration. However, although still negatively correlated, this statistical significance was lost after 2 and 5 months after starting TB treatment (Figures 1).

$$y = -1.4544x + 57.592$$
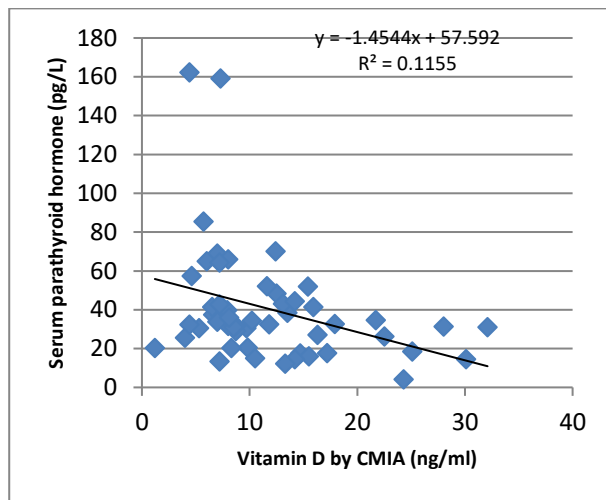$$R^2 = 0.1155$$

Figure 1: Correlation between vitamin D serum concentration measured by chemiluminescent immunoassay, and serum level of parathyroid hormone at baseline (a significant negative correlation, *P= 0.015*).

The relationship between different variables and the mean level of serum vitamin D level in TB patients.

Variables that showed statistically significant differences in the means of vitamin D serum levels include: age (significantly lower level in those below 18 years of age), smoking (unexpectedly, adult male smokers had significantly higher mean level than adult male non-smoker), gender (males had significantly higher level than females), occupation (patients with outdoor occupations had significantly higher levels than indoor ones), and skin color (patients with dark brown had significantly higher mean level than those with light brown skin).

Although statistically insignificant, there was a trend toward increased vitamin D serum level with increasing duration of sun exposure (mean levels of 9.42±5.73, 12.42±7.61 and 13.1±6.98

ng/ml for < 20, 20-60, > 60 minutes of daily sun exposure respectively).

Contribution of various variables to changes in vitamin D serum levels using logistic regression analysis.

Analysis by binary logistic regression showed that age, is the significant contributor to vitamin D deficiency ($P = 0.032$, Odd ratio 1.054, CI: 1.004-1.107).

Discussion

The present study showed that vitamin D deficiency was highly prevalent in TB patients where more than 80% of them had a vitamin D level below 20 ng/ml. Even when a lower cut-off point was used (< 10 ng/ml), the percentage of deficiency was still high. However, it is not different from that in control normal subjects. Several studies had reported that vitamin D deficiency is a risk factor for TB infection.[4 -11] As an example, it was found that 57% of TB patients showed vitamin D deficiency compared with 33% in their controls with a significantly low level of vitamin D in females with TB compared with males.[8] In contrast, Musarurwa et al, [19] had reported that sufficient vitamin D levels were associated with more incidence of sputum smear-positive pulmonary TB. Higher levels of vitamin D were, also, considered a risk factor for progression to active TB.[20]

The highly prevalent vitamin D deficiency in our region does not seem to represent a risk factor for development of tuberculosis, since most of patients with smear-positive pulmonary TB became negative after treatment. Ralph et al.[21], also, found that there was no difference between TB patients and controls regarding 25(OH)D level.

The prevalence of vitamin D deficiency among TB patients varied among different studies conducted in different countries. It is as high as in the present study, and as low as 8.5% in a study conducted in West Africa.[7] These variations may result from the use of different methods of vitamin D assay, different cutt-off points used to define vitamin D deficiency, the presence of co-morbidities among the study population, socioeconomic status, exposure to sunlight, nutrition, race and traditional/cultural traits.[11]

An association between vitamin D deficiency and increased risk of tuberculin skin test conversion, and having an active TB infection among those with latent TB was found by a meta-analysis published by Huang et al.[5] The latter analysis suggested that vitamin D deficiency could be a risk factor for TB more than being a result of its consequences, since the level of vitamin D was not significantly affected by anti-TB treatment. In contrast, vitamin D deficiency was considered as a consequence of TB infection, due to up-regulation and increased expression of CYP27B1, resulting in an increase in the conversion of 25(OH)D to the active $1,25(OH)_2D$. This means that an increase in the level of $1,25(OH)_2D$ occurs with deficiency of 25(OH)D.[5]

In the present study, when patients were followed two months after starting anti-TB treatment, the mean level of serum vitamin D was significantly lower than the mean at baseline. Two months of anti-TB treatment increased the percentage of vitamin D deficient patients (when the cut-off point < 20 ng/ml) to more than 90%, with no patient having sufficient vitamin D range. The

majority (96%) of those followed for 5 months were in the deficient range of vitamin D. A consistent reduction in plasma level of 25(OH)D of about 70% was also found by Brodie et al.[22], in eight males following 2-week administration of daily oral 600 mg of rifampicin. This reduction had been explained by the powerful enzyme inducing effect of rifampicin. Another explanation for this lower mean level of vitamin D after 2 months of starting anti-TB treatment is that the majority of patients in the present study were followed during winter and spring seasons which represent seasons of lower exposure to solar radiation; the main source of vitamin D. A strong association was found between vitamin D deficiency among household contacts and winter/spring seasons.[23] Similarly, Zhao et al.[24] showed that vitamin D deficiency was more among TB patients who were registered in cold months than those registered in warm months and explained that by less exposure to sun during those months. Levis et al.[25], found a statistically significant increase in the concentration of 25(OH)D by 14% during summer season compared with winter.

On the other hand, a study conducted in northern Tanzania showed that the median concentration of 25(OH)D was increased after 2 months of starting anti-TB treatment (from 91 nmol/L to 101 nmol/L). This increase had been attributed to the nutritional improvement and increased exposure to sunlight.[26]

A number of paradoxical results had been encountered in the present study. The correlation of smoking with higher vitamin D levels among TB patients had been mentioned previously. Similarly, and because of vitamin D is a fat-soluble vitamin, it can be stored in adipose tissue and its serum level in obese people is expected to be low.[27] The reverse was found in the present study, whereas the BMI increased, the prevalence of vitamin D deficiency decreased (from 100% deficient with BMI less than 18.5 to 75% with BMI more than 30). This points to the fact that changes in vitamin D level in the blood is difficult to be related to one or two variables and can result from interaction of a good number of factors.

People with darker skin such as African Americans or Hispanics were reported to have much lower vitamin D levels than those with lighter skin. African American race was found to be linked with vitamin D deficiency, where it was found higher than expected, in comparison to Americans with white complexion.[28]

Looker et al.[29] found the mean vitamin D level highest in non-Hispanic whites followed by Mexican Americans, and lowest in non-Hispanic blacks. It had been suggested that absorption of UVB by melanin in people with black skin can affect the synthesis of vitamin D and increase the risk of vitamin D deficiency.[28] In the present study, TB patients with darker skin had significantly higher vitamin D serum levels. In contrast to black race, this dark skin might result from sufficient sun exposure and more vitamin D synthesis.

Conclusion

vitamin D deficiency is highly prevalent in our region, but it does not seem to represent a risk factor for development of tuberculosis. Vitamin D deficiency did not appear to affect the response of patients to anti-TB treatment. Anti-tuberculosis drugs can significantly reduce vitamin D level particularly two months after starting treatment. Analysis by binary logistic regression showed that young age represented a risk factor for vitamin D deficiency.

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الخلاصة

نقص فيتامين "د" والتدرن في البصرة: تاثيرالادوية المضادة للتدرن

خلفية الدراسة: هناك ارتباط بين مستويات فيتامين (د) المنخفضة ومجموعة واسعة من المشكلات الصحية من بينها التدرن.

الهدف: لقياس تركيز فيتامين (د) في مصل الدم بين مرضى التدرن والعينة الضابطة المماثلة لهم قبل البدء بالعلاج، وكذلك عند مرضى التدرن بعد شهرين وخمسة أشهر بعد بدء المعالجة.

الطرائق: تم اجراء هذه الدراسة في مركز البصرة للتدرن وكلية الطب في البصرة (العراق) خلال الفترة من أيلول 2018 إلى حزيران 2019. المشتركين في الدراسة هم المرضى المشخصين حديثاً للاصابة بالتدرن والعينة الضابطة لهم من الذين لا يشكون ظاهريا من اي مرض. تم قياس فيتامين (د) في مصل الدم باستعمال طريقة المقايسة المناعية للجسيمات الدقيقة المتلألئة كيمياوياً, كما تم قياس معايير اخرى (الكالسيوم ، الفوسفور، إنزيم الفوسفاتاز القلوي، هرمون الغدة المجاورة للدرقية) وغيرها.

النتائج: لم يكن هناك فرق معتدّ إحصائياً في معدل مستوى فيتامين (د) بين مرضى التدرن قبل العلاج (وعددهم 56) والعينة الضابطة (وعددهم 57). وكان معدل انتشار نقص فيتامين (د) مرتفعاً في المرضى ومجموعتهم الضابطة عندما تم قياسه قبل البدء بالعلاج حيث كان لدى أكثر من 80٪ منهم مستوى فيتامين (د) أقل من 20 نانوغرام/مل. وعندما تمت متابعة المرضى بعد شهرين من بدء العلاج المضاد للتدرن كان معدل مستوى فيتامين (د) في الدم أقل وبفارق معتد احصائياً مقارنة بمستواه قبل البدء بالعلاج. وعلى الرغم من الانتشار الواسع لنقص فيتامين (د) بين مرضى التدرن, فان جميع مرضى التدرن الرئوي موجبي البلغم, عدا ثلاثة منهم, تحولوا الى سالبي البلغم بعد شهرين من بدء العلاج.

الاستنتاج: يبدو ان نقص فيتامين (د) واسع الانتشار في منطقتنا ولا يوجد فرق معتد اخصائيا في مستوى الفيتامين لدى مرضى التدرن قبل بدء العلاج ومجموعتهم الضابطة, كما وانه لم يؤثر على الاستجابة العلاجية عند مرضى التدرن الرئوي للأدوية المضادة للتدرن