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Correlation of Vitamin D Deficiency with Levothyroxine Requirements Among Hypothyroid Patients in Albayda, Libya

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العلاقة بين نقص فيتامين د واحتياجات الليفوثيروكسين لدى مرضى قصور الغدة الدرقية في مدينة البيضاء، ليبيا

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Abstract:
Hypothyroidism is a widespread endocrine disorder resulting from inadequate thyroid hormone synthesis and is frequently associated with low vitamin D (VitD) levels. Current research has highlighted that VitD may affect thyroid function and levothyroxine treatment response; however, limited data are available for the Libyan population. The current study was designed to determine the correlation between serum VitD concentrations and levothyroxine dosage among hypothyroid patients. A comparative cross-sectional research study was performed in a cohort of one hundred (100) hypothyroid patients receiving levothyroxine at the General Internal Medicine Department, Albayda Medical Center, Albayda, Libya. Demographic and clinical profiles, along with blood samples, were collected from all participants to evaluate serum VitD and thyroid-stimulating hormone (TSH) levels using standard laboratory procedures. Levothyroxine doses were obtained from patients' medical records. Statistical analyses were conducted to examine the correlations among serum VitD levels, levothyroxine dosage, and TSH levels. The results showed a high prevalence of VitD deficiency among hypothyroid individuals. Serum VitD levels were negatively correlated with levothyroxine dosage (r=-0.39, p= 0.006), indicating that patients with lower VitD levels may require higher levothyroxine doses. In addition, lower serum VitD levels were correlated with higher TSH levels (r =-0.34, p=0.003). In conclusion, these results suggest that VitD deficiency is linked to poor thyroid function control and higher levothyroxine dose requirements in hypothyroid patients. Routine assessment of VitD may improve disease management and therapeutic outcomes in this population.

KEYWORDS: Vitamin D (VitD); VitD deficiency; hypothyroidism; levothyroxine dosage; thyroid-stimulating hormone (TSH); Albayda; Libya.

الملخص:
قصور الغدة الدرقية اضطراب غدي شائع ينتج عن نقص في تصنيع هرمون الغدة الدرقية، ويرتبط غالبًا بانخفاض مستويات فيتامين د. قد أشارت الأبحاث الحديثة إلى أن فيتامين د قد يؤثر على وظيفة الغدة الدرقية والاستجابة لعلاج الليفوثيروكسين؛

إلا أن البيانات المتوفرة عن السكان الليبيين محدودة. صُممت هذه الدراسة لتحديد العلاقة بين تركيز فيتامين د في الدم وجرعة الليفوثيروكسين لدى مرضى قصور الغدة الدرقية. أُجريت دراسة بحثية مقطعية مقارنة على مجموعة من مئة (100) مريض بقصور الغدة الدرقية يتلقون علاج الليفوثيروكسين في قسم الطب الباطني العام، مركز البيضاء الطبي، البيضاء، ليبيا. جُمعت البيانات الديموغرافية والسريرية، بالإضافة إلى عينات الدم، من جميع المشاركين لتقييم مستويات فيتامين د وهرمون تحفيز الغدة الدرقية (TSH) في الدم باستخدام إجراءات مخبرية قياسية. حُددت جرعات الليفوثيروكسين من السجلات الطبية للمرضى. أُجريت تحليلات إحصائية لدراسة العلاقات بين مستويات فيتامين د في الدم، وجرعة الليفوثيروكسين، ومستويات هرمون تحفيز الغدة الدرقية (TSH). أظهرت النتائج انتشارًا واسعًا لنقص فيتامين د بين المصابين بقصور الغدة الدرقية. ارتبطت مستويات فيتامين د في الدم عكسيًا بجرعة الليفوثيروكسين (p=0.006, r=-0.39)، مما يشير إلى أن المرضى ذوي مستويات فيتامين د المنخفضة قد يحتاجون إلى جرعات أعلى من الليفوثيروكسين. بالإضافة إلى ذلك، ارتبطت مستويات فيتامين د المنخفضة في الدم بمستويات أعلى من هرمون (p=0.003, r=-0.34) TSH. خلصت الدراسة إلى أن هذه النتائج تشير إلى أن نقص فيتامين د يرتبط بضعف السيطرة على وظائف الغدة الدرقية والحاجة إلى جرعات أعلى من الليفوثيروكسين لدى مرضى قصور الغدة الدرقية. قد يُسهم التقييم الدوري لفيتامين د في تحسين إدارة المرض والنتائج العلاجية لدى هذه الفئة من المرضى.

الكلمات المفتاحية: فيتامين د؛ نقص فيتامين د؛ قصور الغدة الدرقية؛ جرعة الليفوثيروكسين؛ الهرمون المنبه للغدة الدرقية (TSH)؛ البيضاء؛ ليبيا.

Introduction:

Hypothyroidism influences various metabolic processes and commonly associates with symptoms including fatigue, depression, and weight gain (1). Levothyroxine is the standard treatment used to normalize thyroid hormone levels (2). VitD plays an important role in maintaining calcium balance, regulating immune system, and promoting nerve and muscle health (3). Recent studies indicate that VitD deficiency may contribute in the development of various thyroid disorders, including hypothyroidism and autoimmune thyroid diseases (4,5). Current research suggests that VitD may influence thyroid gland function through immunomodulatory pathways and anti-inflammatory mechanisms. Low serum VitD levels have been associated with increased thyroid autoimmunity, elevated TSH levels, and impaired thyroid function (4,6). In a recent meta-analysis, Wang et al. revealed a significant correlation between VitD deficiency and autoimmune thyroid diseases (7). Similarly, according to Unal et al., patients with autoimmune thyroiditis who had VitD deficiency exhibited elevated thyroid antibody levels (8). Previous research has also indicated that VitD deficiency may affect thyroid hormone sensitivity and the therapeutic response to levothyroxine treatment. Nutritional and metabolic factors, including VitD deficiency, may influence levothyroxine requirements and disease control in hypothyroid patients (9). Recent intervention research suggests that VitD supplementation therapy may enhance both thyroid-related biochemical parameters and metabolic profiles among hypothyroid patients (10,11). Several reviews have further emphasized the significant role of VitD in maintaining thyroid function and regulating autoimmune diseases (12,13). Despite most evidence supporting the correlation between VitD deficiency and hypothyroidism, some conflicting findings have been reported (14). Although findings from a previous study indicating a significant link between VitD and calcium deficiencies and hypothyroidism among Libyan patients (15), limited information is available regarding the specific association between serum VitD levels and levothyroxine dosage in this population. Understanding this correlation may help optimize treatment strategies for hypothyroid patients in Libya. Therefore, this study was conducted to assess the correlations among serum VitD concentrations, levothyroxine dosage requirements, and TSH levels in patients with hypothyroidism.

Methods:

This comparative cross-sectional research study was performed at the General Internal Medicine Department, Albayda Medical Center, Albayda, Libya, from January to October 2025. The study included one hundred (100) patients previously diagnosed with hypothyroidism who were receiving levothyroxine therapy. Both male and female participants aged ≥ 18 years were enrolled. Pregnant women, patients with chronic liver or kidney disease, individuals who had received VitD supplement therapy during the last three months, and those with other endocrine disorders affecting calcium or vitamin D metabolism were excluded. Demographic and clinical data, including age, sex, duration of hypothyroidism, levothyroxine dosage, and relevant medical history were obtained from patients' medical records. Before the initiation of the study, the ethical approval was granted by the Medical Ethics Committee of Albayda Medical Center and was performed in compliance with the Declaration of Helsinki (Ethics Approval No.: AMC890/23; approved December 05, 2024). Each participant signed a written informed consent form before study enrollment. Blood samples were obtained from all study participants and analyzed for laboratory biochemical analyses. Serum VitD levels were measured using standard laboratory techniques and expressed in ng/mL. TSH levels were also measured to assess

thyroid function. Patients were classified into VitD-deficient (<20 ng/mL), VitD-insufficient (20–30 ng/mL), and VitD-sufficient (>30 ng/mL) groups based on their serum VitD levels (16). The collected data were analyzed using SPSS statistical software, version 20.0. Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequency and percentage distributions (n, %). Pearson's correlation coefficient analysis was performed to examine the correlations among serum VitD levels, levothyroxine dosage, and TSH levels. Results were considered statistically significant at a significance level of $p<0.05$.

Results:

The demographic and clinical profiles of the 100 patients with hypothyroidism treated with levothyroxine are presented in table 1. The mean age of the participants was 40.0 ± 10.7 years, ranging from 18 to 65 years. Females comprised 80% of the study population, while males accounted for 20%. The mean serum VitD level among participants was 18.9 ± 8.6 ng/mL, while the mean levothyroxine dosage was 99.5 ± 28.4 µg/day. Patients with deficient VitD levels required higher doses of levothyroxine compared with those with sufficient VitD levels. Patients with VitD deficiency exhibited elevated TSH levels more frequently, with the overall mean serum TSH level being 6.7 ± 3.8 mIU/L. As illustrated in table 2, the majority of patients (60%) were VitD deficient, whereas 25% exhibited insufficiency, and 15% had sufficient VitD levels. As shown in tables 3 and 4, lower VitD levels were significantly linked to higher levothyroxine requirements ($r=-0.39$, $p=0.006$) and increased TSH levels ($r=-0.34$, $p=0.003$). VitD deficiency appears to be associated with impaired thyroid function control among patients with hypothyroidism.

Table (1): Demographic & clinical profiles of hypothyroid patients

Variables	Values
Total sample size, (n)	100
Age (years), mean ± SD	40.0 ± 10.7
Age range (years)	18-65
Female, n (%)	80 (80%)
Male, n (%)	20 (20%)
Serum VitD (ng/mL), mean ± SD	18.9 ± 8.6
Levothyroxine dosage (µg/day), mean ± SD	99.5 ± 28.4
Serum TSH (mIU/L), mean ± SD	6.7 ± 3.8

Table (2): Classification of VitD status levels among hypothyroid individuals

VitD Status Levels	Frequencies (Number of Patients, n)	Percentages (%)
Deficient	60	60%
Insufficient	25	25%
Sufficient	15	15%

Table (3): Correlations among serum VitD levels, levothyroxine dosage, and TSH levels in hypothyroid study population

Variables	Pearson's Correlation Coefficient Analysis (r)	p-values
VitD vs levothyroxine dosage	-0.39	0.006
VitD vs. TSH	-0.34	0.003

Table (4): Levothyroxine dosage requirements based on VitD status levels among hypothyroid patients

VitD Status Levels	Levothyroxine Dosage (µg/day), Mean ± SD
Deficient	110.4 ± 29.6
Insufficient	90.7 ± 21.9
Sufficient	71.6 ± 17.8

Discussion:

The results of this study highlight a correlation between serum VitD levels and levothyroxine dosage requirements in hypothyroid individuals. A high prevalence of VitD deficiency was observed in this population, with significant negative associations identified between serum VitD concentrations and both levothyroxine dosage and TSH levels. These results indicate that insufficient VitD levels may be associated with poorer thyroid function management and higher levothyroxine dosage requirements. The majority of patients with hypothyroidism in this study were found to have VitD deficiency. This

observation aligns with recent evidence demonstrating that VitD deficiency is significantly associated with thyroid disorders, particularly hypothyroidism and autoimmune thyroid diseases (17,18). VitD plays a crucial immunomodulatory role, and its deficiency may contribute to thyroid dysfunction through autoimmune mechanisms. The present study also showed that serum VitD levels were significantly and negatively correlated with TSH levels. Patients with lower VitD levels had higher TSH levels, suggesting poorer thyroid function control. Similar findings have reported a significant association between VitD deficiency, autoimmune thyroid diseases, and increased TSH concentrations (19-21). Furthermore, recent studies indicate that VitD supplementation may have beneficial effects on thyroid-related biochemical markers among individuals with hypothyroidism (22). One of the principal findings of this study was the negative correlation observed between serum VitD concentrations and levothyroxine dose requirements. Patients with lower VitD levels required higher doses of levothyroxine. This observation indicates that VitD deficiency may affect thyroid hormone metabolism, tissue responsiveness, or levothyroxine absorption (23). Hoermann et al. reported that nutritional and metabolic factors may influence individualized levothyroxine dosage requirements among hypothyroid patients (24). These findings are consistent with those of a previous study conducted among Libyan hypothyroid patients, which identified significant associations between hypothyroidism and deficiencies of VitD and calcium levels (15). The consistency between current and prior results further emphasizes the clinical importance of monitoring VitD levels among hypothyroid patients in Libya.

Conclusion:

The findings showed a high prevalence of VitD deficiency in hypothyroid patients. Serum VitD levels showed significant negative correlations with levothyroxine dosage and TSH levels, reflecting that lower VitD concentrations are associated with higher levothyroxine requirements and poor thyroid function control. The results indicate that VitD may be an important factor in hypothyroidism management and may affect patients' response to levothyroxine treatment. Routine screening of VitD levels may improve disease monitoring and therapeutic outcomes in hypothyroid patients.

Study Limitations:

Various limitations of the present study should be mentioned. First, the study had a small sample size. Second, the participants were recruited from a single region in Libya, which may limit generalizability. Third, factors affecting vitamin D levels, such as sunlight exposure, seasonal variation, diet, and body mass index (BMI), were not comprehensively evaluated.

Recommendations and future studies:

Based on the study results, routine screening of serum VitD levels is recommended for hypothyroid individuals, particularly those receiving higher doses of levothyroxine. Early detection and management of VitD deficiency may help improve thyroid function and enhance treatment outcomes. Clinicians should consider monitoring VitD levels as part of the comprehensive management of hypothyroid patients. Educating patients about sufficient sunlight exposure, well-balanced diet, and appropriate VitD supplementation may contribute to lowering the risk of VitD deficiency among these individuals. Further large-scale, multicenter studies are recommended to provide a more comprehensive understanding of the link between VitD and levothyroxine dosage in individuals with hypothyroidism and to determine if VitD supplementation can improve thyroid function and treatment effectiveness.

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