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Evaluation of Vitamin D Levels in Kidney Failure Hemodialysis Patients

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Abstract

Introduction : Vitamin D is a fat-soluble prohormone whose metabolism is disrupted by chronic kidney disease (CKD). Indeed, it is in stage 3 of chronic kidney disease that an inadequate conversion of 25(OH)D to 1.25(OH)2D appears. The objective of the study was to evaluate the concentration of vitamin D and its correlation with parameters such as calcium and parathyroid hormone in a population with CKD and hemodialysis.

Methodology : This is a Study involving 35 hemodialysis patients. In these patients, epidemiological parameters were taken and blood samples were taken. Parameters such as vitamin D, calcium and parathyroid hormone were measured on each sample.

Results and Discussion : The majority of patients, 72%, had suboptimal vitamin D concentration, respectively 46% at the insufficiency stage (20-29 ng/ml) and 26% at the deficiency stage
(0-19 ng/ml) of which 3% were severe deficient ; with an average age of 48.97±14.95 years and a predominance of men (57%). A positive and negative correlation between vitamin D and serum calcium and vitamin D and parathyroid hormone, respectively; was found.
And also factors, such as age and gender have been identified as associated with decreased vitamin D concentration.

Keywords: Chronic kidney disease, Hemodialysis, Vitamin D

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Introduction

Vitamin D, also known as calciferol, is a fat-soluble vitamin that is considered a pro-hormone due to its similarity to steroid hormones [1]. Unlike other vitamins that come solely from food,

it has two major origins: on the one hand, through skin synthesis for vitamin D3 (80%) and on the other hand, through diet for D3 and D2 (20%) [2,3].

Vitamin D needs double hydroxylation to be active. First, the liver performs a carbon-25 hydroxylation, to form 25-hydroxyvitamin D (25(OH)D) via 25-OH hydroxylase (CYP2R1). The 25(OH)D thus formed is transported into the bloodstream by the vitamin D binding protein (DBP) to undergo a second hydroxylation at the level of carbon 1 by mitochondrial 1-alpha hydroxylase (CYP27B1) to give the 1,25 (OH)2 D.

Indeed, 1-alpha hydroxylase has been found in other tissues, but it is mainly renal. Thus, pathologies affecting kidney function can be responsible for metabolic abnormalities including a decrease in the action of vitamin D. Among these pathologies, we can mention chronic kidney disease, which exposes you to an increased risk of vitamin D deficiency. This phenomenon contributes to the increased mortality of patients with chronic kidney disease. In the same vein, many observational studies have reported a link between vitamin D deficiency and mortality in CKD [4,5].

In addition, the progressive loss of renal function leads to a deterioration of mineral homeostasis (Levin, Bakris et al. 2007), including dysregulation of tissue and blood concentrations of calcium and phosphorus as well as an imbalance in blood levels of several hormones (PTH, FGF23, calcidiol, calcitriol .....)

At present, hemodialysis is one of the most commonly used means of treatment [7]. It is often combined with vitamin D supplementation depending on the stage of deficiency that must be evaluated. The objective of our study was to evaluate this vitamin D in hemodialysis patients, and to see the impact of the deficiency on certain biological parameters.

Methodology

This was a retrospective study involving 35 patients who had been on hemodialysis for six months without interruption with a complete hospitalization record and followed in the Nephrology Department of the HALD University Hospital in Dakar (Senegal).

In these patients, blood samples were taken and parameters such as: vitamin D, calcium and parathyroid hormone were measured.

The concentration of 25 (OH) vitamin D3 was determined with the multiparametric immunoassay machine based on the proven ELFA (Enzyme Linked Fluorescent Assay) technology with the VIDAS® 3 device. The assay principle combines the two-stage sandwich enzyme-linked immunosorbent immunosorbent method with a final fluorescence detection (ELFA).

The descriptive study was carried out with the calculation of frequencies and proportions for qualitative variables and the calculation of means, standard deviation for quantitative variables. And the results are presented as a mean ± standard deviation, or percentage of patients as the case may be.

Results

Table I : Gender distribution of the study population

Gender	Number of cases	Percentage
Feminine	15	43%
Masculine	20	57%

In our study, end-stage chronic kidney disease was diagnosed in 20 men versus 15 women, or, respectively, 57% versus 43% with a sex ratio (M/F) of 1.33 (Table I)

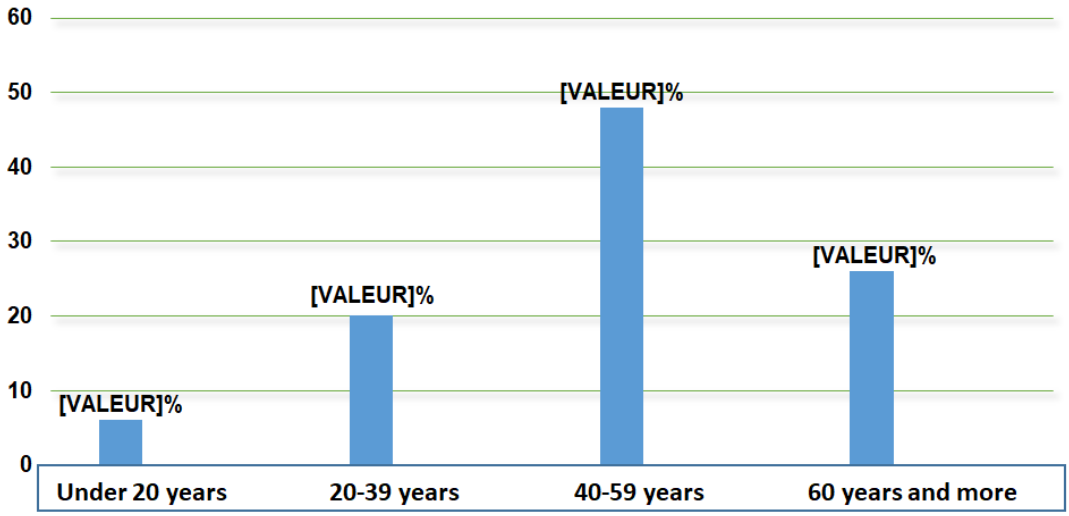

Figure 1: Distribution of the study population by age group

The majority of patients are in the 40-59 age group (48%). There were 20% between the ages of 20 and 39 and only 6% under the age of 20 (Figure 1). The extreme ages were 17 and 73 years.

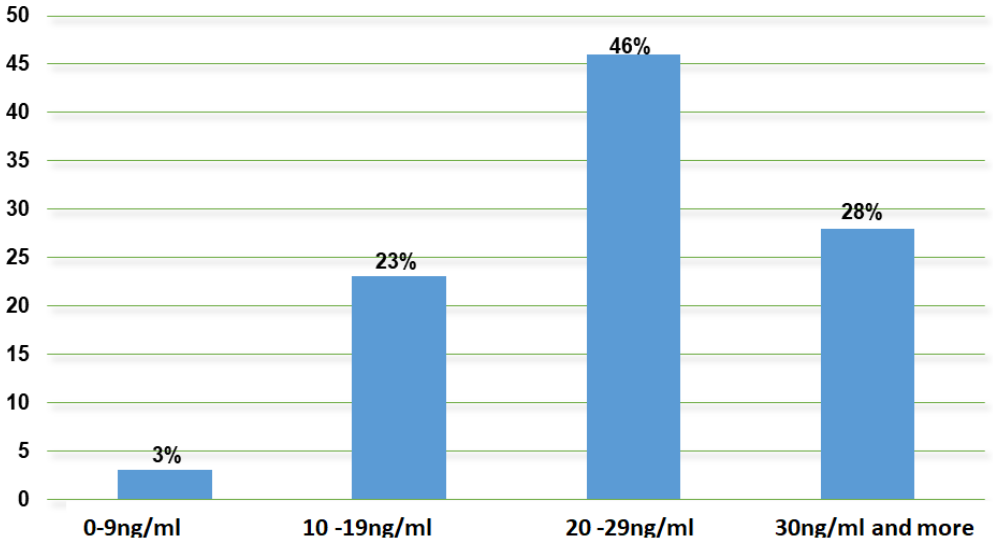

Figure 2 : Serum 25(OH)D concentration

The serum concentrations of 25 (OH) D encountered are in low values. Only 28% of patients have concentrations of 30 ng/ml and above. This means that 72% of patients, i.e. a large majority, have suboptimal concentrations, respectively 46% at the insufficiency stage (20-29 ng/ml) and 26% at the deficiency stage (0-19 ng/ml), including 3% at the severe deficiency stage (Figure 2).

Table II : Distribution of vitamin D concentrations

	Vitamin D deficiency (<20 ng/ml)	Vitamin D insufficiency (20-30 ng/ml)	Normal Vitamin D (>30 ng/ml)
under 20 years old (6%)	0	1 (3%)	1(3%)
20-39 years (20%)	2 (6%)	2 (6%)	3 (9%)
40-59 years (48%)	4 (11%)	9 (26%)	4 (11%)
60 and more (26%)	4 (11%)	3 (8%)	2 (6%)
TOTAL	**28%**	**43%**	**29%**

Among patients with vitamin D deficiency and vitamin D insufficiency, those over 40 years of age were more represented with 22% and 34% of cases respectively. While patients under 20 years of age did not have vitamin D deficiency (Table II).

Table III : Valeurs moyennes des paramètres

Biological parameters	Mean ± Standard Deviation	Reference values
Calcium (mg/l)	89,52 ± 9,04	85 – 105
Parathyroid hormone (pg/ml)	985,29 ± 652,56	15 – 65
Vitamin D (ng/ml)	25,06±8,93	30-70

At the biological level, we note a tendency towards a normal serum calcium level (89.52 mg/l on average), a high PTH level (985.29 pg/ml) and a low average vitamin D level of 25.06 ng/ml (Table III).

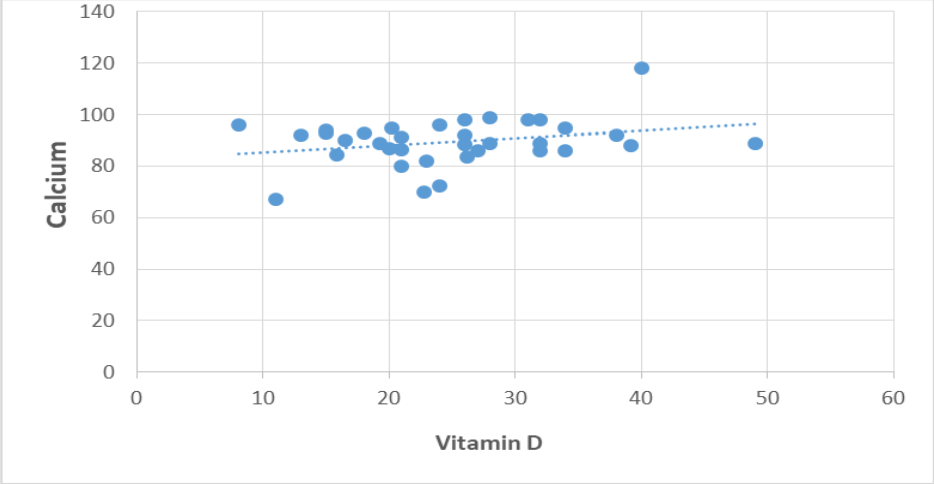

Figure 3 : Correlation between vitamin D and calcium

Figure 3 shows a positive linear relationship between vitamin D levels and serum calcium, with a correlation coefficient of 0.27

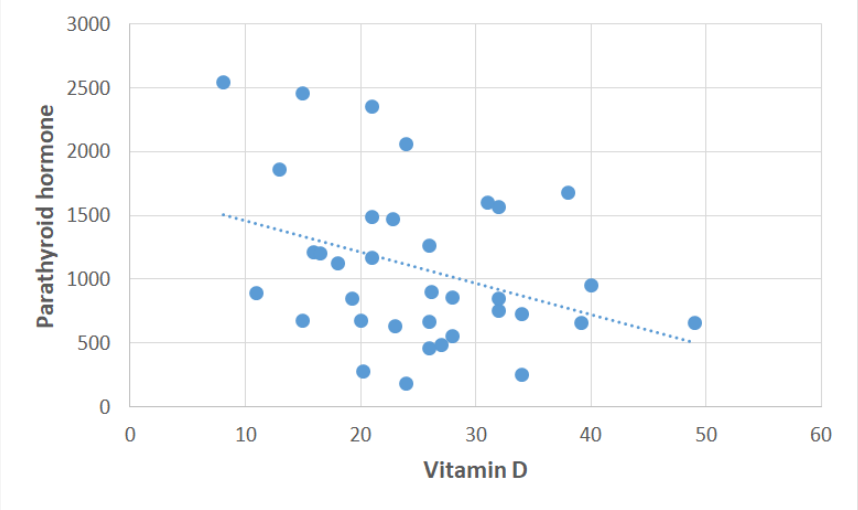

Figure 4 : Correlation between vitamin D and parathyroid hormone

Figure 4 shows a negative linear relationship between vitamin D and parathyroid hormone levels with a correlation coefficient of -0.35

Discussion

Chronic kidney disease (CKD) is a major public health problem, especially since the aging of the population and the steady increase in the prevalence of diabetes and hypertension contribute to its increase in prevalence [8].

CKD is a pathological terrain that exposes patients to an increased risk of vitamin D deficiency, which contributes to the increased mortality of patients with chronic kidney failure. In addition, many observational studies have reported a link between vitamin D deficiency and mortality in CKD [4,5].

Regarding our results, the patients were on average aged 48.97 ± 14.95 years, mostly men (57%) with a median of 25 0H D blood of 25.06 ± 8.93 ng/ml and a sex ratio of 1.33 in favor of men. Other studies conducted in Senegal between 2006 and 2008 by Ka et al found a sex ratio of 1.48 while those by Diop et al between 2006 and 2008 obtained a sex ratio of 1.12 [9].

The male predominance of kidney failure is thought to be related to several factors, including the higher incidence of certain causes of kidney failure in men, and the faster progression of kidney disease in men compared to women [10]. There has been a reversal of the sex ratio in the Australian Aboriginal population [11].

In the African series, the average age varies between 40 and 50 years [12,13]. Thus, in the studies of Coulibaly in Burkina Faso [13] and Ben Abdellah in Morocco [14], the average age was 43.54 years and 49.8 years respectively. The average age is higher in developed countries. It is 71 years for the population studied by the REIN in 2010. In the series of Gbaguidi et al in Martinique, it is 67.5 years [15]. According to Chaabouni et al, the average age was 58.4 years, with extremes ranging from 10 to 100 years ; while Asserraji et al in Morocco had an average age of 49,92±14,97 years [9].

The results show us that renal failure was more common in subjects over 40 years of age (74%). So age is one of the risk factors. Chronic kidney failure, which is widely addressed in the elderly population, is particular because of the entanglement of physiological ageing of renal function on the one hand and poly-pathology and poly-medication on the other.

CKD in its early stages is an important risk factor for 25(OH)D deficiency. The prevalence of vitamin D insufficiency and deficiency is thus around 75% and 30% respectively in CKD [18]. Nearly 43% of our patients were vitamin D deficient and 28% were deficient. So our patients suffered more from vitamin D deficiency than vitamin D deficiency.

The prevalence of vitamin D deficiency increases with worsening of kidney function regardless of age, sex, weight, and race [19].

In our chronic kidney patients, 71% had vitamin D concentrations below the recommended threshold of 30 ng/ml. This percentage is close to the 76% found by Bareto et al [20] and the 80% obtained by Romain in 2016 [21].

Vitamin D has an impact on serum calcium with a positive linear correlation.

Vitamin D testing in the study population resulted in a mean value of 25.06 ± 8.93 ng/ml, associated with a mean serum calcium of 89.52 ± 9.04 mg/l.

Hypocalcemia is observed in 26% of cases; according to the international literature, serum calcium in CKD is low, except in the case of myeloma where hypercalcemia is observed even in the terminal stage. Different results are obtained, for example in Mali [22] with hypocalcemia equal to 70%.

This is because the absorption of calcium from the filtered blood is enhanced by PTH, which stimulates the conversion of vitamin D into its most active form, calcitriol. (Lewis)

According to our study, the mean of PTH is equal to 985.29 ± 652.56 with a negative linear correlation with respect to vitamin D. In patients with renal failure, vitamin D deficiency can lead to an excess of PTH, in order to maintain normal serum calcium at the cost of secondary osteoporosis [23]

Conclusion

The results showed that the decrease in vitamin D concentration in chronic hemodialysis patients

may be associated with factors such as age and gender.

And that there is a correlation between vitamin levels and calcium and PTH levels as found in the literature.

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