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Original Research Article

Research on a protective effect of Vitamin D in the context of COVID-19 in adults on West African hemodialysis

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ABSTRACT

Context: Chronic kidney disease is a worldwide disease with an estimated prevalence of 10% in 2020. In Côte d'Ivoire, the prevalence of this disease is not well known, but hospital studies show prevalences of 7 to 46%. In 2020, hemodialysis patients are particularly at risk of contracting COVID-19. Studies have shown that vitamin D supplementation can not only reduce the risk of getting acute respiratory infections, but has also been associated with a lower susceptibility to severe COVID-19. To this end, a study was undertaken to assess the impact of the pandemic on hemodialysis patients in the public sector of Abidjan, according to their vitamin D status.

Materials and Methods: In a cross-sectional study conducted from November 2021 to August 2022, we included 280 patients with end-stage CKD treated with hemodialysis at the CNPTIR in Abidjan. The collection of epidemiological and clinical data was done on the basis of a questionnaire on the one hand and the medical records of the patients on the other. Vitamin D concentration and COVID-19 serology were determined by the ELFA method with immunochemical detection.

Results: The mean age of the patients was 45.90 ± 12.76 and 66.85% of them were men. 42.70% of patients had been dialysis for more than 5 years. 3/4 of the study population had a positive serology for COVID-19. The mean vitamin D concentration in patients was 23.04 ng/ml of which 38.20% were vitamin D deficient. 94.57% of patients did not experience severe signs of COVID-19. There was no significant difference between mean vitamin D concentrations in serology-positive versus serology-negative patients, and mean vitamin D values in patients with severe and non-severe symptomatology.

Conclusion: Our study did not show a protective effect of vitamin D against covid-19 in Ivorian hemodialysis patients.

1. Introduction

In the context of COVID-19, hemodialysis (PH) patients represent a particularly at-risk population. Firstly, because of their pathology, they belong to the group of populations said to be at risk of developing severe forms of the COVID-19 disease with the elderly, diabetics and liver failure.[1] In addition, the requirement to go to the dialysis centre twice a week for sessions lasting several hours in an enclosed space with other patients increases their susceptibility to contracting the virus.

Several studies have described a beneficial role of vitamin D not only in reducing the risk of acute respiratory infections[2] but also a lower susceptibility to progression to severe disease for vitamin D concentrations greater than or equal to 20 ng/ml.[3]

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The present study aims to assess the impact of the COVID-19 pandemic on hemodialysis patients in the public sector of Abidjan, with regard to their vitamin D status.

2. Materials and Methods

2.1. Ethical considerations

This study was approved by the Comité National d'Ethique et de la Recherche (CNER) of the Ministry of Health and Public Hygiene of the Republic of Côte d'Ivoire. A free and informed consent form was obtained from all participants.

2.2. Participants

This is a cross-sectional study extended from November 2021 to August 2022 on a population of black African adults of both sexes, suffering from end-stage CKD. These patients are treated by hemodialysis at the public dialysis center in Abidjan (CNPTIR: National Center for the Prevention and Treatment of Renal Failure). Sampling was carried out by successive recruitment allowing the inclusion of 178 patients who had given their consent for the study.

2.3. Methods

For each participant in the study, the collection of epidemio-clinical data was done by an interview using a pre-established survey sheet, as well as by the study of the medical records of the center's patients. The information collected related to age; gender, length of dialysis, associated pathologies, symptoms of COVID-19 disease, vaccination against COVID-19, COVID-19 PCR test.

COVID-19 IgG/IgM serology and serum 25-hydroxyvitamin D assay were performed by ELFA (Enzym-Linked Fluorescent Assay) method on Biomérieux's mini-VIDAS® brand immunoassay automaton (Ref: 423834-01 and 423833-01 for anti-COVID-19 IgG and IgM and Ref: 30463 for 25(OH) vitD).

At the end of the COVID-19 serological tests, patients were classified into two categories: "Exposed" patients for those with IgG + IgM – or IgG + IgM + profiles and "unexposed" patients for those with the IgG – IgM profile –

Based on symptomatology, patients were divided into two groups: Patients with severe COVID-19 symptomatology and Patients with non-severe COVID-19 symptomatology;

Patients with non-severe COVID-19 symptoms were considered to be those with one or more of the following signs: fever, cough, asthenia, anorexia, shortness of breath, myalgia, diarrhea, and vomiting.

Patients with severe COVID-19 symptoms were considered to be patients who had a positive PCR test (PCR+) associated with respiratory distress or who had been hospitalized for COVID-19 in the three months prior to the serological tests.

In the context of the COVID-19 pandemic, several studies agree on the value of 20 ng/mL as a protective threshold for vitamin D concentration. Thus, in the present study, patients will be divided into two groups: patients with sufficient vitamin D concentration (Vit D ≥ 20 ng/mL) and patients with insufficient vitamin D concentration (Vit D <20 ng/mL)

2.4. Statistical analyses

The data processing required Excel 2016 and EPI-INFO version 7.

The qualitative variables were described in terms of numbers and percentages for each of the variable modalities.

The comparison of the different means between the variables was made using the Mann-Whitney test. The significance threshold has been set at 5%.

3. Results

More than half of the study population is under 50 years old (30.90%). The average age of patients is 46 years with a maximum of 79 years. Male patients represent twice the number of women, i.e. a sex ratio (M/F) of 2. Almost half of the patients (42.70%) have been on dialysis for more than 5 years.

Hypertension is associated with CKD in almost all patients (98.3%) in our study.

Approximately three-quarters of the study population tested positive for COVID-19. Out of 129 patients with a positive serology, only 44 (34.11%) had a PCR test. In terms of symptoms, only 5.5% of patients showed severe signs of COVID-19 (all tested positive on PCR).

More than one-third (38.20%) of patients are vitamin D deficient. The average vitamin D in our series is 23.04 ng/mL with a maximum of 52.40 ng/mL and a minimum of 08 ng/mL.

Mean vitamin D concentrations were not significantly different in serology-positive versus serology-negative patients.

The mean vitamin D value in the group of patients who did not experience severe symptoms of COVID-19 was not significantly different from that of the group of patients who experienced severe symptoms.

4. Discussion

4.1. Epidemiological data

The average age of our sample (46 ± 13 years), and the majority representation of patients under 50 years of age (62.36%), reflects the relative youth of the hemodialysis patients in our study as in most African countries. Indeed, this result corroborates those of previous studies in Africa

Table 1: Patientcharacteristics

Characteristics	Values
Age (years)	
Mean ± standard deviation	45,90 ± 12,76
< 50 years n(%)	111 (62,35%)
≥ 50 years n(%)	67 (37,65%)
Sex	
Men n (%)	120 (67,42%)
Women n (%)	58 (32,58%)
Length of dialysis	
< 5 years n(%)	102 (57,3%)
≥ 5 years n(%)	76 (42,7%)

Table 2: Distribution of the study population by chronic kidney disease

Associated pathologies	Number (n)	Percentage (%)
HTA	131	73,59
Diabetes	01	0,56
HTA +Diabète	12	6,74
HTA +VIH	10	5,62
HTA +Diabète + Autres	03	1,69
HTA +VIH +Autres	01	0,56
HTA +Autres	18	10,11
Autres	02	0,57
Total	178	100

*Other pathologies: chronic gastroraphy, heart failure, hepatitis B, hepatitis C, chronic heart disease, sickle cell anemia, stroke, chronic lung disease, dry pericarditis.

Table 3: Laboratory and clinical assessment of patients

Characteristics	Values
COVID-19 Serology	
IgG+/IgM+ n(%)	13 (7,30%)
IgG+/IgM- n(%)	116 (65,17%)
IgG-/IgM- n(%)	49 (27,53%)
Clinical signs of COVID-19	
Serious n (%)	7(5,43%)
Not serious or absent (%)	122 (94,57%)
Concentration of 25(0H)D (ng/mL)	
Average ± SD	23,04 ± 10,68
Median (min-max)	23,1 (8 – 52,5)
≥ 20 ng/mL	110 (61,8%)
< 20 ng/mL	68 (38,2%)

Table 4: V: Average vitamin D concentration value based on COVID-19 serology results

		Vitamine D		
		Mean	Standard deviation	p
COVID-19 Serology	Serology + (n=129) Serology - (n=49)	22,90 23,42	9,09 7,11	0,609

Table 5: Mean Vitamin D Concentration Based on Clinical Signs

		Vitamine D (ng/mL)		
		Mean	Standard deviation	p
Symptoms of COVID-19	Serious	23,83	9,31	0,799
	Not serious or absent	22,85	9,11	

on kidney failure in particular, in particular that of Yao[4] in 2018 in Côte d'Ivoire and Gerard[5] in 2016 in Burkina Faso with average ages of 39 and 45 years respectively.

In contrast, in Caucasian populations in developed countries, including the United Kingdom and the United States, the average age of CKD patients is greater than 60 years.[6,7] This age difference between African countries and the West can be explained in particular by the ageing of the Western population, where life expectancy is higher than in Africa, and by better management of cardiovascular risk factors, thus delaying the onset of kidney failure in certain chronic diseases.

Our study showed a male predominance (sex ratio of 2 men to 1 woman) as generally observed in many studies both in Africa (Tsévi in Togo,[8] Halle[9] in Cameroon) and in the West (kidney report France 2019).

In our series, the average length of time spent on hemodialysis treatment (about 5 years) is relatively low compared to other countries, particularly in Morocco where Mhammedi et al.[10] in 2019 reported a dialysis period of up to ten years. Late diagnoses combined with a modest economic level of patients and a lack of dialysis machines in the public sector contribute to a decline in the quality of care.

4.2. Clinical-biological data

About 73% of patients had contact with SARS-COV-2, as evidenced by IgG+ and/or IgM+ COVID-19 serology. Very little data is available on COVID 19 serology in the general Ivorian population over the same period; but this result corroborates that of Sakhi[11] a year earlier in the Paris region, with a positive initial SARS-CoV-2 IgG serology in 89% of dialysis patients.

In the three months prior to their COVID-19 status, more than 94% of patients did not show severe signs of the disease. Non-serious signs were dominated by fever (13.95%), cough (15.50%) and asthenia (13.95%). The same order of clinical signs is reported in the meta-analysis by Chen et al.[12] investigating the incidence and clinical impacts of COVID-19 infection in patients undergoing haemodialysis, with fever (reported in 19 studies, 61.4%), followed by cough (19 studies, 46.8%), dyspnoea (16 studies, 35.2%), and asthenia (12 studies, 35.2%).

In addition, in our cohort, out of the 129 patients who had been in contact with the virus, only 7 (5.43%), confirmed by PCR, presented serious signs of dyspnea and respiratory distress requiring hospitalization.

However, several studies in the West have found much higher rates of hospitalized patients with severe signs of COVID-19.

In Turkey in 2020, Turgutalp et al.[13] report out of 567 haemodialysis patients, 23.6% of patients admitted to intensive care units and 16.3% of deaths. In Canada, Taji in 2021[14] reports even higher rates: 62.6% hospitalization with a mortality rate of 28.3%. Several hypotheses have been put forward to try to explain this finding aimed at presenting a greater immunity in Africans, particularly the age group. Indeed, people over 65 years old are known to be more vulnerable to COVID, but according to the age pyramid, the African continent is relatively young, with this age group in relatively small proportions, particularly in our cohort of dialysis patients.

The mean vitamin D concentration in our entire hemodialysis patient series was 23.04± 10.68 ng/mL. That of patients with positive serology (22.90 ± 9.09 ng/ml) was not significantly different from that of patients with negative serology (23.42 ± 7.11 ng/ml).

Similarly, vitamin D concentrations were not significantly different between COVID-19 patients with signs of severity and the group of those without (23.83 vs 22.85 ng/ml).

In other words, the protective effect of vitamin D against COVID-19 and the risk of developing severe forms, mentioned by many authors, was not found in our series of hemodialysis patients.

Yet, Kaufman et al.[15] in 2020 showed that SARSCoV-2 positivity is strongly and inversely associated with circulating 25-OH-D concentration in the U.S. population of the District of Columbia.

Similarly, Ilie,[16] Merzon[17] and Arteaga-Müller[18] respectively in European, Italian and Israeli populations, reported a negative correlation between vitamin D concentrations and COVID-19 cases on the one hand, and ICU admissions with death on the other.

Several mechanisms are put forward by these authors to explain this beneficial role of vitamin D. The active hormone 1,25-OH-2D plays an important role in gene regulation via the enzyme 1alpha-hydroxylase, which then encodes proteins needed for tight junctions (e.g. occludin), gap junctions (e.g. connection 43) and adhesion junctions (e.g. E-cadherin).[19–21] In addition, vitamin D also strengthens innate cellular immunity, in particular through the induction of antimicrobial peptides, including human cathelicidin LL-37 and defensins,;[22,23] then by the reduction of the cytokine storm induced by the innate immune system.[24]

In addition, vitamin D is a modulator of adaptive immunity; It also promotes the induction of regulatory T cells, thereby inhibiting inflammatory processes.[25]

However, the vast majority of studies describing this beneficial effect of vitamin D on COVID-19 have been carried out in the general population.

Paradoxically, studies specifically concerning CKD patients on dialysis or not do not report this finding. As in our series, studies by Oristrell[26] in 2021 in Spain, Arenas Jimenezand Can[27,28] did not find a significant association between circulating levels of 25 hydroxyvitamin D and outcomes in chronic kidney disease in their series, including

ICU admission and mortality.

This result suggests that the mechanisms of vitamin D in protection against COVID-19 in the general population may be disrupted in CKD patients. This hypothesis remains to be verified.

In addition, it should be noted that among the 7 patients who developed severe forms despite vitamin D concentrations > 20 ng/mL, 5 were over 50 years old, one was diabetic and one had heart failure. These elements, known as factors in the severity of COVID-19, may have contributed to the worsening of the disease regardless of vitamin D concentration.

5. Conclusion

From our study, which aimed to assess the impact of the pandemic in COVID19 on hemodialysis patients in the public sector of Abidjan with regard to their vitamin D status, it appears that there is no significant difference between the vitamin D concentrations of patients with positive and negative serology on the one hand and patients with severe and non-serious symptoms on the other hand.

The vitamin D concentration of the patients in our series does not seem to have modulated their response to the deleterious effects of COVID-19, in other words, the protective effect of vitamin D was not demonstrated in our study.

6. Source of Funding

None.

7. Conflict of Interest

None.

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