

The effect Toxoplasmosis on some biochemical parameters among hemodialysis patients in Kirkuk City/ Iraq

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ABSTRACT: Background: *Toxoplasma gondii* is a widely distributed parasite infection that presents as an increased risk in immunocompromised persons such as hemodialysis patients. The aim of this study was to determine the effect of Toxoplasmosis on some biochemical parameters among hemodialysis patients.

Materials and Methods: This study was carried out on 180 individuals (130 were hemodialysis patients and 50 were healthy groups). All serum samples were tested serologically using enzyme linked immunosorbent assay (ELISA) technique to detect all of anti-Toxoplasmosis (IgM-IgG) antibodies and biochemically using Mini VIDA were measured serum 25-hydroxy vitamin D and serum Ferritin.

Results: Overall, 180 participated in this study, the seropositivity were identified in the sera of 36.11%. IgM and IgG seroprevalence rate of Toxoplasmosis in hemodialysis patients was 4.62% and 34.61%. While IgM and IgG seroprevalence rate of Toxoplasmosis

in healthy groups were 0% and 28% respectively. Additionally, the levels of 25-hydroxy vitamin D were low in hemodialysis patients infected with toxoplasmosis in comparison with hemodialysis patients without toxoplasmosis. On the other hand, the levels of serum ferritin were raised significantly in hemodialysis patients infected with toxoplasmosis compared to other groups in this study.

Conclusions: Screening test for *Toxoplasma gondii* in hemodialysis patients considered as an essential step to avoid infection dissemination among them and Infection with *Toxoplasma gondii* had adverse impact on Serum 25-hydroxy vitamin D and serum ferritin in hemodialysis patients.

Keyword: *Toxoplasma gondii*, Hemodialysis, ELISA, Serum 25-hydroxy vitamin D and serum ferritin.

Introduction

The obligate intracellular protozoan parasite *Toxoplasma gondii* inhabits host tissues and can infect any warm-blooded animal, including human beings, birds, and rodents. While most *T. gondii* infections remain asymptomatic, immuno-compromised individuals such as hemodialysis patients face a heightened risk of reactivation, which can trigger potentially fatal central nervous system complications [1].

Consequently, toxoplasmosis presents a major health concern for patients with chronic kidney disease (CKD), particularly those on hemodialysis whose impaired immune defenses increase their vulnerability. Because of the substantial morbidity and mortality linked to this infection, precise diagnostic techniques are essential for proper patient identification and management, typically relying on the detection of specific anti-*Toxoplasma* Ig G and IgM antibodies [2]. CKD represents a widespread global health issue that disproportionately affects adults over the age of 60. Defined by structural or functional kidney damage, CKD involves a loss of more than 50% of normal renal capacity [3]. Hemodialysis patients are inherently immunocompromised due to dysfunctions in phagocytosis, chemotaxis, and the complement system, making them far more susceptible to opportunistic pathogens like *T. gondii* compared to healthy populations [4]. In terms of host physiology, iron storage plays a central role in cellular and organismal iron balance. The protein ferritin mediates intracellular iron storage by sequestering excess iron in a non-reactive redox state for later utilization during deficiency or increased demand.

Beyond assessing iron status, cellular and systemic ferritin levels serve as vital biomarkers for inflammatory, immunological and malignant conditions [5].

Additionally, vitamin D, a fat-soluble steroid vitamin, is crucial not only for skeletal integrity but also for immune regulation, cellular differentiation, and anti-inflammatory pathways. Growing evidence supports its supportive role in preventing and managing infections. Circulating Vitamin D reaches the renal proximal tubular epithelial cells, where mitochondrial 1 α -hydroxylase regulated by parathyroid hormone, serum phosphorus levels, and other factors convert it into highly active Vitamin D. This active metabolite binds to vitamin D receptors widely expressed in immune cells, keratinocytes, and tissues like the prostate and small intestine. Through this interaction, it regulates intestinal calcium and phosphate absorption, supports bone mineralization, maintains mineral balance, and modulates immune function and cell proliferation [6,7].

Finally, hemodialysis serves as a primary renal replacement therapy for end-stage renal dysfunction. Utilizing a dialyzer equipped with semi-membranes alongside an arteriovenous fistula or graft, this procedure filters out excess fluids and metabolic waste products. Standard treatment protocols typically require three- to four-hour sessions administered three times a week [8,9].

Material and Methods

Study design and study populations

This cross-sectional study was conducted on a total of 130 serum samples from hemodialysis patients (55 of them were female and 75 patients were male with aged 16- 88 years) in Al-Amal dialysis center, Kirkuk, Iraq from March 2026 to June 2026.

Sample collection

Approximately 3 mL of venous blood were collected from hemodialysis patients using a sterile syringe and put into sterile gel tubes. Test tubes were left at room temperature for 20-30 *mins* to allow the blood to clot, then centrifuged at 3000 rpm for 5- 10 *mins*. The sera were then put in Eppendorf tubes and kept in a freezer (-20°C) until it was used.

Enzyme-linked immunosorbent assay (ELISA)

This test was used for detection anti-Toxoplasmosis IgM and IgG antibodies using (Sunlong Biotech Co., Ltd, china) according to the protocols provided by the manufacturer company of the kit.

Mini VIDAS

Mini VIDAS® is an automated immunoassay analyzer manufactured by bioMérieux. It is designed for performing a wide range of immunological and infectious disease tests in clinical laboratories.

The system uses ELFA (Enzyme-Linked Fluorescent Assay) technology, which combines enzyme immunoassay principles with fluorescence detection to provide quantitative or qualitative results were designed to estimate the Serum 25-hydroxy vitamin D and serum ferritin.

Ethical approval

At the beginning of the study, the official ethical approval was obtained to conduct the study from the Kirkuk Directorate of Health / Ministry of health/ Iraq. The participants were informed about the purpose and procedure for taking information from them who attended Al-Amal dialysis center.

Statistical analysis

The data were analyzed using T test by Prism software (Version 7). P-values of <0.05 were considered statistically significant.

Results

From the 130 hemodialysis patients, the results showed that the anti-toxoplasma antibodies (IgG and IgM) seropositivity were identified in the sera of (51) 39.23% hemodialysis patients as is seen in Table (1)

Table (1): The Sero-prevalence of *Toxoplasma Gondi* immunoglobulin IgM and IgG

Hemodialysis group (130 patients)	No.	%	Control group (50 patients)	No.	%
IgM ⁺ IgG ⁻	6	4.62%	IgM ⁺ IgG ⁻	0	0
IgM ⁻ IgG ⁺	45	34.61%	IgM ⁻ IgG ⁺	14	28%

IgM ⁺ IgG ⁺	0	0	IgM ⁺ IgG ⁺	0	0
Total	51	39.23%	Total	14	28%

The table one shows a significantly higher prevalence rates of anti-toxoplasmosis IgM and IgG antibodies in the hemodialysis patients were in comparison of control group.

Table (2): The mean levels of serum ferritin and vitamin D among hemodialysis patients according to presence or absence of Toxoplasmosis antibodies.

Parameters	Hemodialysis with Toxoplasmosis +ve	Hemodialysis with Toxoplasmosis –ve
	Mean±SD	Mean±SD
Serum Ferritin	565.51 ± 41.97***	507.71 ± 30.56
Serum Vitamin D	24.89±1.23***	30.41±2.07

* * * Indicate significant, SD: Standard deviation, +ve: Positive, -ve: Negative, the normal value of vitamin D (30-100) ng/ml. The normal value of serum ferritin in male (70-435) ng/ml and in female (10-160) ng/ml.

DISCUSSION

Toxoplasmosis ranks among the most widespread global parasitic infections due to its versatile transmission modes across various mammalian hosts [10]. The current study revealed a marked increase in the seroprevalence of toxoplasmosis in hemodialysis patients (39.23%) compared to the control cohort (28%). This elevated rate in hemodialysis patients can be attributed to heightened susceptibility resulting from impaired T-cell-mediated immunity, which stems from chronic inflammation driven by the accumulation of urea and metabolic waste products in renal failure. Additionally, immune dysfunction affecting phagocytic cells, chemotaxis, and the complement system predisposes these individuals to opportunistic pathogens, or leads to the reactivation of latent infections [11,12,13]. These observations aligned with regional and international findings; Hamada *et al.* reported IgG and Ig M seropositivity rates of 35.21% and 29.16% in Kirkuk, while Mirahmadi *et al.* recorded rates of 44.5% and 23.5% among hemodialysis patients and healthy controls, respectively [14,15]. It is well established that patients undergoing hemodialysis inherently suffer from chronic inflammation and metabolic disturbances, including impaired 1α-hydroxylase activity leading to baseline vitamin D deficiency [6,7].

Vitamin D plays a pivotal role in modulating immune function, with evidence suggesting that adequate vitamin D administration suppresses *Toxoplasma* proliferation [16]. Upon evaluating the connection between vitamin D status and toxoplasmosis, serum vitamin D levels were significantly lower in *Toxoplasma*-positive cases than in their seronegative counterparts. This trend implies that vitamin D deficiency compromises immune competence, thereby increasing vulnerability to toxoplasmosis [17]. This finding is consistent with reports by Rashid *et al.* and Kashanet *al.* regarding the strong link between vitamin D3 deficiency and *T. gondii* infection [16,17].

The pathogenicity of *T. gondii* relies on its intracellular replication within host cells, which alters host physiology. This study investigated the relationship between parasite infection and ferritin a major iron-storage protein vital for iron homeostasis and the regulation of pro-oxidant stress during inflammatory states. Because tissue macrophages serve as the primary origin of ferritin, intracellular parasite replication triggers an inflammatory response accompanied by oxidative stress. This activation of macrophages upregulates ferritin synthesis, driving iron sequestration to deprive the parasite of essential iron while protecting host tissues [5,18,19]. These outcomes consist with studies by Domínguez-Rojas *et al.*, Shariatet *al.*, and Abd El Wahabet *al.*, all of which observed elevated serum ferritin levels in patients with toxoplasmosis [18,20,21,22].

Conclusions

The findings of the current study was demonstrated that serological detection of the *T.gondii* infection particularly in immunocompromised patients are necessary requirement to prevent infection dissemination and this study has been explored the link between infection of toxoplasmosis and serum ferritin and 25-hydroxy vitamin D levels.

Recommendations

It is recommended to incorporate routine screening for *Toxoplasma gondii* infection into the standard care protocols for hemodialysis patients, along with regular monitoring of serum ferritin and vitamin D levels, to evaluate immune status and mitigate potential clinical complications.

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