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RESEARCH ARTICLE

RISK FACTORS ASSOCIATED WITH SEROPREVALENCE OF TOXOPLASMA GONDII AMONG RENAL FAILURE PATIENTS

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Abstract

Toxoplasma gondii (*T. gondii*) is one of the most prevalent zoonotic opportunistic parasitic infections in the world. The current study aimed to determine the seroprevalence of *T. gondii* and to identify the risk factors among renal failure patients undergoing hemodialysis in Artificial Kidney Center in Mukalla, Hadhramout/Yemen during a period from December 2021 to March 2022. A cross-sectional study was conducted among 95 hemodialysis patients 68(71.58%) were males and 27(28.42%) were females. Data regarding to associated variables were collected using a structured questionnaire, and the samples of serum were collected and investigated for *T. gondii* specific immunoglobulin G (IgG) and M (IgM) by using enzyme linked immunosorbent assay ELISA. Data was analyzed using SPSS statistical software version 24 and a P value<0.05 was taken statistically significant. The results revealed that 92(96.84%) patients had anti-Toxo IgG, 1(1.05%) patients had anti-Toxo IgM. Toxo IgG was detected in a higher rate in males than that in female 69.5% and 28(4%) respectively. there was significantly association of *T. gondii* infection when detected by IgG antibody test with hemodialysis number >3 (COR=22.250, CI 95%= 1.168-423.952, P=0.039), and with blood transfusion (COR=17.600, CI 95%=0.954-324.568, P=0.054). However, the gender, age groups, Marital status, education, occupation, residence, household size, water source, cat contact, cat feces contacting, eating raw meat, eating restaurant food, smoking, washing vegetables, duration of hemodialysis, transplantation, family history of *T. gondii*, surgery operation and history of disease were not significantly associated with seroprevalence of *T. gondii* IgG. The prevalence of *T. gondii* infection among HD patients in Mukalla city was high. Therefore, we recommend monitoring these patients for *T. gondii* infection to minimize the spreading of toxoplasmosis via treating the seropositive patients with the available commercial drugs.

Keywords: Seroprevalence; *Toxoplasma gondii*; Risk factors; ELISA technique; Hemodialysis.

Introduction

Toxoplasmosis is a zoonotic infection caused by the intracellular protozoan *Toxoplasma gondii* (*T. gondii*) [1]. It is one of the most serious infectious diseases in immunocompromised people. It can lead to serious complications or even death [2]. *T. gondii* transmitted to human by ingestion raw contaminated meat, ingestion sporulated oocystes in unwashed vegetables or untreated water, contact with cats, drinking unpasteurized milk, transplacentally, through organ transplantation, and blood transfusion [3,1]. Global seroprevalence studies indicate that around 30% of the human population worldwide have been exposed to T.gondii with prevalence varying by region due to environmental and life lifestyle factors [4]. Clinical aspects of toxoplasmosis infection linked to the host immune system Toxoplasmosis in people with a complete immune system is asymptomatic or mild and transient, with mild fever and swollen lymph glands, but in patients with a weakened immune system for any reason, such as AIDS patients, transplant recipients, and HD patients, the latent form of the parasite can be reactivated, causing a variety of clinical complications ranging from lymph swelling to central nervous system damage, epilepsy, brain damage ,encephalitis, pneumonia and myocarditis [5,6]. The investigation of parasitic infections in patients

with HD, followed by the desired treatment if tested positive, can, therefore play a significant role in the process of restoring better quality of life for these patients. The main objective of this research is to determine the seroprevalence of anti-*T. gondii* IgM and IgG and to identify the risk factors among renal failure patients undergoing hemodialysis in Artificial Kidney Center in Mukalla, Hadhramout.

Materials and Methods

Study Design

A cross-sectional study was conducted in Hadhramout coast region during a period from December 2021 to March 2022.

Sample Size and Study Population

A total of 95 blood samples were collected from patients of renal failure undergo the hemodialysis in the Artificial Kidney Center in Mukalla, Hadhramout, Yemen.

Data Collection

A standardized, interview-administered, structured questionnaire was developed to obtain data regarding *T. gondii* infection associated variables. It consisted of systematic question on sociodemographic variables of gender, marital status, level of education, occupation, residence and household size; behaviors and practices variables of source of drinking water, contact with cats, contact with cat feces, contact with soil, eating of raw/undercooked meat, eating in restaurants, smoking and washing vegetables; clinical variables of duration of hemodialysis in years, number of hemodialysis in months, history of previous blood transfusion, history of transplantation, family history of *T. gondii* infection, history of diseases (HBV, HCV, diabetic, hypertension, heart disease and surgery operation).

Specimens Collection and Preparation

Blood samples collection according to the Kit instruction manual for ELISA technique. About 5ml venous blood was drawn in to a clean dry tube and then allowed to clot at room temperature 20-25ºC. Samples were separated to obtain serum at 3000 rpm for 10 minutes. The serum was transferred to micro-centrifuge tubes, numbered and stored at -20ºC till examination. The specimens were transported to the national center of central public health laboratories Mukalla/ Hadhramout in a plastic container under refrigeration in ice box for detection of *T. gondii* in serum specimens by ELISA. All sera and reagents were allowed to stand at room temperature before use in the test.

Detection of T. gondii

Enzyme linked immunosorbent assay (ELISA) CDS, Russia was used to test for the presence of anti-*T. gondii* IgG and IgM antibodies according to the manufacturer′s instructions.

Ethical Consideration

Research ethical approval of this study was obtained from Faculty of Sciences, Hadhramout University. Written consent was obtained before commencing the study. Permission letter was obtained from the Artificial Kidney Center administration Mukalla, Hadhramout. The information was taken from the participants after they agreed to it verbally according to the informed consent with confidentiality of each study participant's result.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) version-24 was used for data analysis. Binary and multiple regression tests (crude odds ratio/adjusted odds ratio) were used to detect independent predictors of *T. gondii* (The association between different variables and outcome of *T. gondii*). The level of statistical significance was set at p-value < 0.05.

Results

Socio-Demographic and Clinical Characteristics of The Hemodialysis Patients

Among HD patients, majority of the study participants were males 71.58%. Most of the studied patients 41.05% were on the age group 50-60 years, married patients represented 76.84% of the participants. Regarding to educational status primary and illiterate accounted for the highest percentage, 38.95% and 27.37% respectively. About 35.79% and 24.21% of the participants were unemployed and housewife respectively. Majority of the participants were coming from urban areas 72.6%. Family size of 6-9 persons was the highest percentage 48.42%. About 34.74%, 23.16%, 48.42%, 43.16%, 73.68 and 81.05% of participants had drinking unsanitary water, cat contact, cat feces contacting, soil contact, eating raw meat, eating restaurant foods, and washing vegetables respectively. About 16.84% of the participants were smoking. Also, most of the participants reported to undergoing dialysis for 1-5 years 44.21%. Regarding number of hemodialysis more than 3 times per month had the highest percentage 92.63%. The majority of the studied patients reported history of blood transfusion 91.58%. About 98.95%, 100% of participants had no transplantation and no family history of *T. gondii* respectively. About 7.37%, 13.68%, 22.11%,71.58%, 22.11% and 31.58% of participants had HCV, HBV, diabetic, hypertension, heart disease and surgery operation respectively as presented in table (1).

Table (1): Socio-demographic and clinical characteristics of the hemodialysis patients

Characteristic	Category	No.	%
Gender	Male	68	71.58
	Female	27	28.42
Age groups/years	Less than 20	1	1.05
	20-39	18	18.95
	40-49	23	24.21
	50-60	39	41.05
	More than 60	14	14.74
Marital status	Married	73	76.84
	Single	16	16.84
	Others	6	6.32
Education level	Primary school	37	38.95
	High school	23	24.21
	University	9	9.47
	Academy	0	0
	Illiterate	26	27.37
Occupation	Unemployed	34	35.79
	Student	1	1.05
	Housewife	23	24.21
	Employee	9	9.47
	Worker	13	13.68
	Retired	15	15.79
Residence	Urban	69	72.6
	Rural	26	27.37
Household size	3-5	27	28.42
	6-9	46	48.42
	More than 9	22	23.16
Smoking	Yes	16	16.84
	No	79	83.16
Duration of hemodialysis	Less than 1	22	23.16
	1-5	42	44.21
	More than 5	31	32.63
Number of hemodialysis	1-3	7	7.37
	More than 3	88	92.63
Blood transfusion	Yes	87	91.58
	No	8	8.42
Transplantation	Yes	1	1.05
	No	94	98.95
Family history of *T. gondii*	Yes	0	0
	No	95	100
Water source	Sanitary water	62	65.26
	Unsanitary water	33	34.74
Cat contact	Yes	22	23.16
	No	73	76.84
Cat feces contacting	Yes	16	16.84
	No	79	83.16
Soil contact	Yes	46	48.42
	No	49	51.58
Eating raw meat	Yes	41	43.16
	No	54	56.84
Eating restaurant foods	Yes	70	73.68
	No	25	26.32
Washing vegetables	Yes	77	81.05
	No	18	18.95
HCV	Yes	7	7.37
	No	88	92.63
HBV	Yes	13	13.68
	No	82	86.32
Diabetic	Yes	21	22.11
	No	74	77.89
Hypertension	Yes	68	71.58
	No	27	28.42
Heart disease	Yes	21	22.11
	No	74	77.89
Surgery operation	Yes	30	31.58
	No	65	68.42

Over All Prevalence of Anti-T. Gondii IgG and IgM

The total seroprevalence of *T. gondii* infection among HD patients screened by ELISA immunoassay of IgG was 96.84% which indicates prior exposure to *T. gondii*, and 1.05% were positive for *T. gondii* IgM which indicates a cute (recent) infection, as presented in table (2).

Table (2): Overall prevalence of anti-*T. gondii* IgG and IgM

Antibody assay	Sero-positivity		Sero-negativity	
	No.	%	No.	%
T. gondii IgG	92	96.84	3	3.16
T. gondii IgM	1	1.05	94	98.95

Prevalence of T. gondii IgG and IgM Antibodies to Socio-Demographic, Behaviors, Practices and Clinical Characteristics of HD Patients

For socio-demographic, behaviors and clinical variables, there was a significantly association of *T. gondii* infection when detected by IgG antibody test with number of hemodialysis >3 (COR=22.250, CI95%=1.168-423.952, P=0.039). Also, with blood transfusion (COR=17.600, CI95%=0.954-324.568, P=0.054), and no significantly association with other variables, while for IgM antibody test was no significantly associated with socio-demographic, behaviors, practices and clinical variables(P>0.05) as presented in table (3).

Prevalence of T. gondii IgG and IgM Antibodies In Relation to History of Disease

There was no significantly association for anti-*T. gondii* IgG and IgM tests p>0.05 with history of diseases as showed in table (4).

Table (3): Seroprevalence of *T. gondii* infection in relation to socio-demographic, behaviors and clinical characteristics of HD patients

Variable	Categories	Positive cases ELISA IgM		COR	95% CI	P-value	Positive cases ELISA IgG		COR	95% CI	P-value
		No.	%				No.	%			
Gender	Male	1	1.1	24111564.78	0.000	0.998	66	69.5	1	0.000	0.998
	Female	0	0.0	1	-	-	27	28.4	1	-	-
Age groups (years)	Less than 20	0	0.0	1	-	-	1	1.1	1	-	-
	20-39	0	0.0	1	0.000	1	17	17.9	1	0.000	1
	40-49	1	1.1	73430653.47	0.000	1	23	24.2	1	0.000	1
	50-60	0	0.0	1	0.000	1	39	41.1	1	0.000	1
	More than 60	0	0.0	1	0.000	1	13	13.7	1	0.000	1
Marital status	Married	1	1.1	22437150.42	0.000	0.999	72	75.8	4.8	0.284-81.101	0.277
	Single	0	0.0	1	-	-	15	15.8	1	-	-
	Others	0	0.0	1	0.000	1	6	6.3	107698324.3	0.000	0.999
Educational level	Illiterate	0	0.0	1	-	-	25	26.3	1	-	-
	Primary	0	0.0	1	0.000	1	37	38.9	64618994.58	0.000	0.998
	High school	1	1.1	73430674.42	0.000	0.998	22	23.2	0.12	0.052-14.918	0.929
	University	0	0.0	1	0.000	1	9	9.5	64618994.63	0.000	0.999
Occupation	Unemployed	0	0.0	1	0.000	1	32	33.7	1	0.000	0.999
	Student	0	0.0	1	0.000	1	1	1.1	1	0.000	1
	Housewife	0	0.0	1	0.000	1	23	24.2	1	0.000	1
	Employee	0	0.0	1	0.000	1	9	9.5	1	0.000	1
	Worker	1	1.1	134622900.0	0.000	0.999	13	13.7	1	0.000	1
	Retired	0	0.0	1	-	-	15	15.8	1	-	-
Residence	Urban	1	1.1	23756982.92	0.000	0.998	68	71.6	2.720	0.164-45.155	0.485
	Rural	0	0.0	1	-	-	25	26.3	1	-	-
Household size/person	3-5	1	1.1	1	-	-	27	28.4	1	-	-
	6-9	0	0.0	1	0.000	0.998	45	47.4	1	0.000	0.998
	> 9	0	0.0	1	0.000	0.998	21	22.1	1	0.000	0.998
Water source	Sanitary water	0	0.0	1	-	-	61	64.2	1	-	-
	Unsanitary water	1	1.1	50483588.78	0.000	0.997	32	33.7	0.475	0.032-8.667	0.652
Cat contact	Yes	0	0.0	1	0.000	0.998	20	21.1	1	0.000	0.997
	No	1	1.1	1	-	-	73	76.8	1	-	-
Cat feces contacting	Yes	0	0.0	1	0.000	0.999	14	14.7	1	0.000	0.997
	No	1	1.1	1	-	-	79	83.2	1	-	-

*Statistically significant at *P-value* <0.05

Key: COR, Crude Odds Ratio; CI, Confidence Interval

Table (4): Prevalence of *T. gondii* IgG and IgM antibodies in relation to history of disease

Variable	Categories	Positive cases ELISA IgM		COR	95% CI	P-value	Positive cases ELISA IgG		COR	95% CI	P-value
		No.	%				No.	%			
Hepatitis C virus infection	Yes	0	0.0	1	0.000	0.999	7	7.4	57400279.18	0.000	0.999
	No	1	1.1	1	-	-	86	90.5	1	-	-
Hepatitis B virus infection	Yes	0	0.0	1	0.000	0.999	12	12.6	1	0.000	0.995
	No	1	1.1	1	-	-	81	85.3	1	-	-
Diabetes	Yes	0	0.0	1	0.000	0.998	21	22.1	5.627	0.000	1
	No	1	1.1	1	-	-	72	75.8	1	-	-
Hypertension	Yes	1	1.1	22714091.85	0.000	0.998	68	71.6	1.231	0.000	0.994
	No	0	0.0	1	-	-	25	26.3	1	-	-
Heart diseases	Yes	0	0.0	1	0.000	0.998	21	22.1	30568317.17	0.000	0.998
	No	1	1.1	1	-	-	72	75.8	1	-	-
Surgery operation	Yes	0	0.0	1	0.000	0.998	29	30.5	1	0.000	0.995
	No	1	1.1	1	-	-	64	67.4	1	-	-

Multivariate logistic regression analysis was performed for associated clinical variables that showed significant at the crude odds ratio calculation for positive cases IgG. The association remains significantly between *T. gondii* infection and number of hemodialysis, while no significant association with blood transfusion as given in Table 5.

Table (5): Adjusted ratio for number of hemodialysis and blood transfusion with *T. gondii* infection among HD patients

Characteristic	Category	Positive cases ELISA IgG		
		AOR	CI	P-value
Hemodialysis number	1-3	1	1	-
	>3	16.248	0.656-402.568	0.059*
Blood transfusion	Yes	12.790	0.517-312.415	0.120
	No	1	1	-

*Statistically significant at P-value <0.05

Key: AOR, Adjusted Odds Ratio; CI, Confidence Interval

Discussion

Studies have shown that there is a immunodeficiency in renal failure patient such as HD patient and these patients have a high risk for many infections [7]. There is no evidence about toxoplasmosis in hemodialysis Hadhramout governorate/Yemen. Thus, the aim of this study is to determine the prevalence of *T. gondii* antibodies in patients undergoing hemodialysis.

The anti-Toxo IgG seroprevalence of 96.84% in Mukalla city is relatively high, suggesting a continuous transmission of endemic Toxoplasmosis in the region. This prevalence of comparable to many studies, In Egypt, the prevalence of anti-Toxo IgG was 60% and 88.2% [8,9] respectively, Sudan 73.3% [10], Iraq 80.9% [11], Iran 76.8%, 73.7%, 63%, 67.3%, 70.2%, and 80% [12-17] respectively, Brazil 68.96% [18]. The reported seropervalence of Toxo IgG antibody in this study is higher than reported in Egypt 22% and 31.7% [19,20] respectively, Iraq 31.11%, 30.9%, 12.6%, 25%, 32.25%, and 48% [21-26] respectively, Iran 44.5%, 40%, 27.7%, 43.8%, 58%, 56.7%, 40.67, and 59.10% [27-33,7] respectively, Libya 23.7% [34], Turkey 56.06% [35], Malaysia 46.6 % [36]. These data suggest that there is high transmission rate of *T. gondii* in Mukalla city, Hadhramout.

The current study recorded anti-Toxo IgM seropositvity 1.05% among hemodialysis patients that represent recent infection. This prevalence was comparable to study in Turkey 1.73% [35]. The seropositvity of anti-Toxo IgM in this study was lower than that recorded in Egypt 2%, 3.3%, and 14.6% [8,19,20] respectively, Iraq 2.82% and 19.6% [22,26] respectively, Iran 9.5 %, 2.17%, 2.1%, 6.3%, 2%, 13.5%, 8.67% and 6.80% [7,12,28-33] respectively, Malaysia 5.7% [37]. The seropositivity of anti-Toxo IgM in this study was higher than that recorded in Iran 0.74% [15] and in Brazil 0.99% [18]. The variations in the seroprevalence could be as a result of epidemic which go unnoticed due the gentle nature of the infection, also this differences may be due to seroprevalence estimated, may vary widely between countries (from 10 to 18) and often within a given country or between different countries in the same region [37].

In the current study *T. gondii* IgG and IgM were detected in a higher rate in males 69.5%, 1.1%, respectively with no significantly association. Similar results findings showed in other studies [9,14,16,28,36,38,39]. But the result does not agree with some studies [25,30,40]. In this study, the highest rate of *T. gondii* infection was found in HD patients within the age group 50-60 years old 41.1% with no statistically significant association. Similar results showed in other studies [9,10,23,25,28,36,41,42]. Some studies do not agree with our results [21,38,43,44]. The high seroprevalence in old age group is maybe due to increase contact with causative agent, and the decrease the immunity in old age patients.

In this study the highest rate of anti-*T. gondii* IgG and IgM were found in married patients 75.8% and 1.1%, respectively with no statistically significant association. Similar results of some studies showed that married patients tend to be more exposed than single to *T. gondii* infection [34,36]. Another study does not agree with our study [24]. This may be attributed to the local facts that married statue of females are responsible for houses and contacts with vegetables and meat during meal preparation. In the present study, primary and illiterate had the highest rate of anti-*T. gondii* IgG with no statistically significant association. Similar results showed that primary level had the highest seroprevalence of *T. gondii* infection and identified as significant risk *T. gondii* infection [36]. Another study showed that there was significant correlation between *T. gondii* seropositivity and study level and the higher infection reported in illiterate 45.2% [34]. Also, the highest prevalence rate observed in illiterate [45]. Another study showed that the highest seroprevalence of anti-Toxo IgG was found in academic degree 40% followed by illiterate patients 37.5% [29]. Other study found that the diploma or low education level had the highest seroprevalence [28].

Majority of patients infected with *T. gondii* in this study were unemployed with a percentage of 33.7% of anti-Toxo IgG, and there was insignificant statistical association. This result agrees with results recorded in Iran [28]. But the result does not agree with [41] in Brazil, [34] in Libya showed that there was statistically

significant between occupation and rate of infection, and [36] recorded that the highest seroprevalence of anti-*T. gondii* antibodies was in laborer. This difference may be due to life style and exposure to infection.

In the present study, the majority of positivity *T. gondii* infection of IgG and IgM of patients were from Urban area with insignificantly associated. This agrees with some studies [17,19,21,22,28,46,47]. Some studies do not agree with our results showed that the highest seroprevalence of *T. gondii* antibodies was in rural than urban [16,21,29,48]. The high seroprevalence of toxoplasmosis in urban than rural maybe due to the contamination and crowd in the city which is more than that in rural.

In the present study there was no significant association of *T. gondii* infection and source of water drinking. Some studies agree with our results [34,36]. Other studies showed a significant relationship [28,49,50,51]. In our study there was no significant association between seroprevalence of *T-gondii* infection and contact with cats. Previous studies agree with our results [9,34,36,52]. Other studies do not agree [28,29,53].

In this study, there was no significant association for other variables of cat feces contacting and soil contact. A study was carried out in China showed that exposure with soil was significantly associated with *T. gondii* infection [54]. Our study showed that there was no significant statistical association between eating raw meat and *T. gondii* infection. This agrees with previous studies [34,36]. Other studies do not agree with our results [28,29,55]. In the present study there was no statistically significantly association for other variables of eating restaurant foods and washing vegetables. The highest seropositive of anti-Toxo lgG and IgM was in patients who eating restaurant foods 71.6 %, 1.1% respectively. [49] identified eating restaurant foods as a risk factor. Another study showed that *T. gondii* seropositivity was associated with unwashed raw vegetables or fruits [41].

In this study, there was no significant association between duration of hemodialysis and *T. gondii* infection, this agree with study carried out in Iran [14], and correlation was shown in study of [26] In this study, there was significantly association of *T. gondii* infection when detected by IgG antibody test with number of hemodialysis >3 and blood transfusion, while for IgM antibody test was insignificant association. Our results showed that 92.6 % of seropositive patients received blood transfusions with significantly association. A study carried out in Egypt agree with our results [9]. But the result does not agree with [36] in Malaysia which showed that there was no significant association. In the current study, there was no significant association of *T. gondii* infection detected by IgG and IgM antibodies with transplantation, family history of *T. gondii* infection, and history of disease such as HCV, HBV, diabetic, hypertension, heart disease and surgery operation.

Conclusion

The study revealed that the seroprevalence of anti-*T. gondii* IgG are high in Mukalla city, Hadhramout with a significant proportion of HD patients at risk of contracting primary *T. gondii* infection. The seroprevalence of *T. gondii* IgG was not significantly associated with gender, age groups, Marital status, education, occupation, residence, household size, smoking, duration of HD, family history of *T. gondii*, surgery operation and history of disease. Also, number of HD and blood transfusion, was statistically significant associated of seroprevalence of *T. gondii* IgG. Screening tests for *T. gondii* infection should be included as a routine screening protocol in all hemodialysis centers. More public awareness and health education efforts are needed.

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Conflict of Interest

No conflict of interest associated with this research.

Author's Contribution

The manuscript was prepared, written and approved in collaboration with the authors.

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مقالة بحثية

عوامل الخطورة المرتبطة بالانتشار المصلي للمقوسة القوندية لدى مرضى الفشل الكلوي

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المُلخّص

التوكسوبلازما غوندي هي واحدة من أكثر أنواع العدوى الطفيلية الانتهازية حيوانية المصدر انتشارًا في العالم. هدفت الدراسة الحالية إلى تحديد الانتشار المصلي للمقوسة الغوندية وتحديد عوامل الخطر بين مرضى الفشل الكلوي الذين يخضعون لغسيل الكلى في مركز الكلى الصناعي في المكلا، حضرموت / اليمن خلال الفترة من ديسمبر 2021 إلى مارس 2022. أجريت دراسة مقطعية على 95 مريضاً بالغسيل الكلوي، 68 (71.58%) ذكور و27 (28.42%) إناث. تم جمع البيانات المتعلقة بالمتغيرات المرتبطة باستخدام استبيان منظم، وتم جمع عينات المصل وفحصها للجلوبيولين المناعي النوعي G (IgG) وM (IgM) باستخدام مقايسة الممتز المناعي المرتبط بالإنزيم (الاليزا). تم تحليل البيانات باستخدام الإصدار 24 من البرنامج الإحصائي SPSS وتم أخذ قيمة P <0.05 ذات دلالة إحصائية. أظهرت النتائج أن 92 (96.84%) من المرضى لديهم مضاد التوكسو IgG، و1 (1.05%) من المرضى لديهم مضاد التوكسو IgM. تم الكشف عن التوكسو IgG بمعدل أعلى في الذكور عنه في الإناث 69.5% و28(4%) على التوالي. كان هناك ارتباط ملحوظ بين عدوى المقوسة الغوندية عند اكتشافها بواسطة اختبار الأجسام المضادة IgG مع عدد مرات غسيل الكلى <3 مرات (COR=22.250، 95% CI =1.168-423.952 ، P=0.039)، ومع تاريخ سابق لنقل الدم (COR=17.600، 95% CI =0.954-324.568 ، P = 0.054). بينما، الجنس، الفئات العمرية، الحالة المادية، التعليم، المهنة، الإقامة، حجم المنزل، مصدر المياه، الاتصال بالقطط، الاتصال ببراز القطط، تناول اللحوم النيئة، تناول طعام المطاعم، التدخين، غسل الخضروات، مدة غسيل الكلى، زرع الكلى، التاريخ العائلي للمقوسة الغوندية، العمليات الجراحية وتاريخ مرضي سابق لم تظهر أي ارتباط معنوي مع الانتشار المصلي للمقوسة الغوندية IgG. كان معدل انتشار عدوى المقوسة الغوندية بين مرضى HD في مدينة المكلا مرتفعا. ولذلك، نوصي بمراقبة هؤلاء المرضى بحثًا عن عدوى المقوسة الغوندية لتقليل انتشار داء المقوسات عن طريق علاج المرضى إيجابيي المصل بالأدوية التجارية المتاحة.

الكلمات المفتاحية: الانتشار المصلي؛ المقوسة القوندية؛ عوامل الخطورة؛ تقنية الليزا؛ غسيل الكلى.

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