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Assessment of the impact of cytomegalovirus seropositivity on blood parameters in renal hemodialysis patients

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Abstract

End-stage renal disease (ESRD) patients are considered immunocompromised, putting them at high risk for infections, including cytomegalovirus (CMV). CMV can affect hematological parameters, causing further complications in ESRD patients. This study intended to determine the seropositivity of CMV infection in hemodialysis patients and its effect on different blood parameters in ESRD patients to help decrease the overall dialysis associated morbidity and mortality. Blood samples were collected from 45 ESRD patients and 45 controls. A complete blood count was performed using an automated cell counter. CMV-specific IgM and IgG levels were measured using immunochemistry testing. The seropositivity for CMV-IgG was 42.2% in ESRD patients which was significantly higher than in control group (22.2%) (p=0.042). The seropositivity for CMV-IgM was 6.7% in ESRD patients with no difference with the control group (4.4%). The prevalence of anemia was significantly higher in CMV seropositive (77.3%) compared to CMV seronegative (47.8%) ESRD patients. Other studied blood parameters were not different between CMV seronegative and seropositive ESRD patients. In conclusion, CMV infection is a significant concern for dialysis patients and can affect hematological parameters, leading to further complications. Early detection and treatment of CMV infection and monitoring of CMV IgM and IgG levels are critical to prevent further complications and improve clinical outcomes.

Keywords: Hemodialysis; Cytomegalovirus; Anemia

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Introduction

Patients with end-stage renal disease (ESRD) are considered immunocompromised evidenced by their high risk of infection (20%), poor response to vaccines, and develop lymphoma and myeloma likely due to their immunodeficiency.[1,2]

A considerable rise in uremic toxins and cytokines as a result of impaired renal function

causes a significant amount of oxidative stress and the release of pro-inflammatory cytokines. Both innate and adaptive immunity are impaired by this inflammatory uremic environment.[3] The immunocompromised state associated with uremia leads to heightened susceptibility of ESRD patients to infections, which continue to be a significant cause of morbidity and mortality in this population.[4] Additionally, dialysis itself can cause inflammation and contribute to changes in the immune system.[5] A significant contributor to morbidity and mortality in ESRD patients are infectious diseases. After cardiovascular disease and treatment discontinuation, infections rank as the primary cause for hospitalization and the third-leading cause of death.[6]

Cytomegalovirus (CMV) is one of the most common viral infections in humans and belongs to the *Herpesviridae* family, which causes symptoms ranging from mild flu-like symptoms to severe complications such as organ failure and death. The prevalence of antibodies in adults varies between 30% and 90% by geographic region, with lower rates in Europe, North America and parts of Australia, and higher rates in Africa and Asia.[5,7–10]

Saliva, urine, blood, cervicovaginal fluid, semen, and breast milk have all been shown to contain CMV. The virus typically spreads to children through infected saliva. In both adolescents and adults, sexual transmission is a significant route of transmission. Additionally, transmission can occur through blood transfusions and organ transplants, and can remain dormant in the body for years.[11] In otherwise healthy children and adults, primary CMV infection is typically asymptomatic[7] However, there are many reports of severe CMV infection manifestations in immunocompromised people.[6]

Cytomegalovirus infection is prevalent in dialysis patients and can cause hematological problems, complications, and increased morbidity and mortality.[8] So, early detection and treatment, along with monitoring of CMV IgM and IgG levels, are crucial to prevent complications and improve laboratory and clinical outcomes in ESRD patients.

Therefore, we conducted this study to assess the seropositivity of CMV infection and its effect on different blood parameters in ESRD patients to help decrease the overall dialysis associated morbidity and mortality.

Patients and Methods

This was a case control study, conducted over a 6-months period in the Nephrology Dialysis Unit and Department of Clinical Pathology at Suez Canal University Hospitals. A total of 45 patients with definitive diagnosis of ESRD on regular hemodialysis were included from both genders and above 18 years. We obtained data regarding the medical history of renal failure and hemodialysis history by examining medical records and conducting in-person interviews.

The control group included 45 normal subjects matching the patients in age and sex and attending the internal medicine and family medicine outpatient clinics at Suez Canal University Hospitals for routine checkup without any symptoms of a severe febrile illness.

The study protocol was reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Suez Canal University (Research 5339**#**, dated June 2023). A written informed consent was obtained from every participant before being included in the study.

The following investigations were done for all the study subjects: Complete blood count (CBC) was determined by an automated cell counter (XP 300™ Automated Hematology Analyzer, Sysmex, Japan), according to the manufacturer's instructions. The severity of anemia was classified according to the hemoglobin (Hgb) concentration into mild (10-11.9 gm/dL female, 12.9 gm/dL male), moderate (8-9.9 gm/dL), severe (6.5-7.9 gm/dL) and life threatening (less than 6.5 gm/dL).[12]

Biochemical tests including serum ferritin was performed by a fully automated clinical chemistry analyzer (BT 1500, Biotecnica, Italy), according to the manufacturer's instructions.

Assessment of serum levels of CMV-IgG and IgM antibodies was performed using an immunochemistry analyzer (Roche/Hitachi

COBAS® 6000 analyzer series, USA), according to the manufacturer's instructions. For this assessment, a venous blood sample (5 ml) was collected from each study participant. The samples were centrifuged immediately to separate the serum at 980 xg for 5 min at 4°C. Serum samples were kept frozen at -20 °C until the time of analysis. CMV-IgG and IgM serum levels were assessed and expressed as arbitrary units/ml (AU/ml). Following the manufacturer's guidelines, a test result exceeding 1 AU/ml and 5 AU/ml were considered positive for the presence of CMV-specific IgM and IgG antibodies, respectively.

Statistical Analysis

Data were fed to the computer and analyzed using the Statistical Package for the Social Sciences (SPSS) software package version 20.0. (Armonk, NY: IBM Corp). Categorical data were represented as numbers and percentages. We used Chi-square test to compare between two groups. Alternatively, Fisher Exact or Monte Carlo correction test was applied when more than 20% of the cells have expected count less than 5. Continuous data were tested for normality by the Shapiro-Wilk test. Quantitative data were expressed as range (minimum and maximum), mean, standard deviation and median for normally distributed quantitative variables. The Student t-test was used to compare two groups. On the other hand, for not normally distributed quantitative variables, Mann Whitney test was used to compare two groups while one way ANOVA test was used for comparing the four studied groups. Spearman coefficient was used to correlate between not normally distributed quantitative variables. Regression was used to detect the most independent/ affecting factor for affecting anemia, leukopenia and thrombocytopenia. The significance of the obtained results was judged at the 5% level.

Results

A total of 45 ESRD patients on regular hemodialysis were included in the study, of which 48.9 % (n=22) were males and 51.1 % (n=23) were females with mean age of 35.6 ± 15.7 years. Of these, 24 patients (53.3%) were on erythropoietin treatment. Among these, 40 patients (88.8 %) have primary renal diseases as small size kidney (n=12; 26.7%), obstructive nephropathy (n=8; 17.8%), congenital (n=6; 13.4%), lupus nephritis (n=3; 6.7%), hypertensive nephropathy (n=2; 4.4%), glomerulonephritis (n=2; 4.4%), single kidney (n=2; 4.4%), diabetes mellitus (n=2; 4.4%), atrophic kidneys (n=1, 2.2%), Familial Mediterranean fever/amyloidosis (n=1, 2.2%) and polycystic kidney (n=1, 2.2%). The mean serum ferritin concentration was 310.2 ± 178.3.

In addition, 45 normal individuals were also included as a control group. Of these, 21 subjects (46.7%) were males and 24 (53.3 %) were females with mean age of 35.1 ± 14.3. Regarding the presence of other comorbidities, hypertension and diabetes mellitus were almost similar in both groups (p>0.05) while 3 (6.7 %) of patients have systemic lupus erythematosus.

The comparison between patients and controls regarding different blood parameters in CBC showed that all the blood parameters including the mean red blood cells (RBCs) count, mean Hgb concentration, mean hematocrit (HCT) value, the mean corpuscular hemoglobin (MCH), the mean corpuscular hemoglobin concentration (MCHC), the median white blood cells (WBCs) count and the median count of the differential WBCs (neutrophils and lymphocytes) were significantly lower in ESRD patients compared to control group (p < 0.001). However, the median monocytes, eosinophils and basophils counts were significantly higher in patients compared to the control group.

Of the 45 ESRD patients, 28 (62.2%) were presented with anemia which was classified into mild (n=9; 20.0%), moderate (n=11; 24.4%), severe (n=6; 13.4%) and life threatening (n=2; 4.4%), while only 11 (24.4%) of the control group were presented with anemia classified as mild (n=9; 20.0%), moderate (n=1; 2.2%) and severe (n=1; 2.2%) with statistically significant differences (p <0.001) (Figure 1). Leucopenia and thrombocytopenia were present in 20 % and 11.1 %, respectively of the ESRD patients and in 6.7 % and 2.2 %, respectively of the control group with no statistically significant differences (Figure 1).

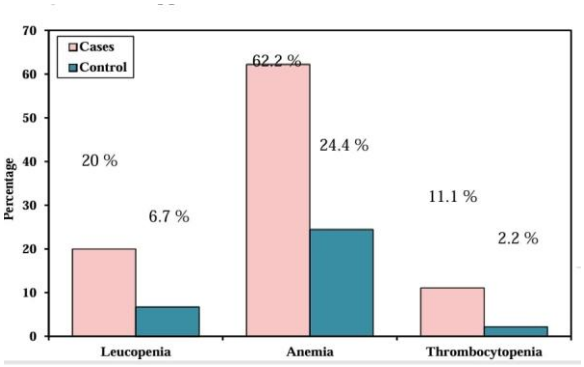

Figure 1. Comparison of the percentage of leucopenia, anemia and thrombocytopenia between the two studied groups.

The seroprevalence of CMV infection among hemodialysis patients was 48.9 % (n=22) but only 26.7% (n=12) among the control group with statistically significant difference (*p*= 0.030). The seropositivity for CMV-IgG was 42.2% (n=19) in ESRD patients which was significantly higher than in control group (22.2%; n=10) (*p*=0.042). The seropositivity for CMV-IgM was 6.7% (n=3) in ESRD patients and 4.4% (n=2) in control group with no statistically significant differences (*p*=1.000) (Table 1).

Table 1. Comparison between the two studied groups according to cytomegalovirus (CMV).

	Cases (n = 45)	Control (n = 45)	*p* value
CMV IgM			
Seronegative	42 (93.3%)	43 (95.6%)	^{FE}NS
Seropositive	3 (6.7%)	2 (4.4%)	
CMV IgG			
Seronegative	26 (57.8%)	35 (77.8%)	$^{\chi 2}$0.042
Seropositive	19 (42.2%)	10 (22.2%)	
Seroprevalence (both IgM and IgG)			
Negative	23 (51.1%)	33 (73.3%)	$^{\chi 2}$0.030
Positive	22 (48.9%)	12 (26.7%)	
CMV			
IgM only	3 (6.7%)	2 (4.4%)	
IgG only	19 (42.2%)	10 (22.2%)	^{MC}NS
Both positive	0 (0%)	0 (0%)	
Both negative	23 (51.1%)	33 (73.3%)	

χ^2: Chi square test FE: Fisher Exact MC: Monte Carlo $p > 0.05$ is not significant (NS).
p: p value for comparing between the two studied groups.

The relation between different blood parameters and CMV seroprevalence in the two studied groups is illustrated in Tables 2 and 3. The mean Hgb concentration was significantly higher in CMV seronegative compared to seropositive ESRD patients (*p*= 0.016), while the prevalence of anemia was significantly higher in CMV seropositive (77.3%; n=17) compared to CMV seronegative (47.8%; n=11) ESRD patients (*p*=0.042). There were no statistically significant differences in other blood parameters between CMV seronegative and seropositive ESRD patients.

Table 2. The relation between different blood parameters and cytomegalovirus (CMV) seroprevalence in the two studied groups.

Parameter	Cases		Control		*p*	p_1
	Seronegative (n =23)	Seropositive (n =22)	Seronegative (n = 33)	Seropositive (n = 12)		
RBC (Mean ± SD)	3.9 ± 0.8	3.6 ± 0.9	4.4 ± 0.5	4.5 ± 0.5	^{F}<0.001	^{F}NS
Hgb (Mean ± SD)	11.3 ± 2.2	9.7 ± 2.2	13.7 ± 1.2	11.2 ± 1.6	^{F}<0.001	^{F}0.016
Anemia	11 (47.8%)	17 (77.3%)	1 (3%)	10 (83.3%)	χ^2<0.001	$\chi^2$0.042
Severity of anemia						
Mild	5 (21.7%)	4 (18.2%)	1 (3%)	8 (66.7%)		
Moderate	5 (21.7%)	6 (27.3%)	0 (0%)	1 (8.3%)	^{MC}<0.001	^{MC}NS
Severe	1 (4.3%)	5 (22.7%)	0 (0%)	1 (8.3%)		
Life threatening	0 (0%)	2 (9.1%)	0 (0%)	0 (0%)		
HCT (Mean ± SD)	31.03 ± 4.73	28.42 ± 5.36	37.86 ± 6.16	36.58 ± 5.76	^{F}<0.001	^{F}NS
MCV (Median (Min. – Max)	83.3 (33.8– 96.9)	81.9 (70.6 – 110)	85.8 (50.2– 109)	82.3 (68– 92.78)	^{H}0.370	^{H}>0.05
MCH Median (Min. – Max.)	27.7 (21 – 33.1)	26.4 (3.4 – 36.0)	30 (14.7 – 34.3)	27.7 (22.8 – 31.5)	^{H}0.001	^{H}NS
MCHC Median (Min. – Max.)	32.7 (31 – 34.3)	32.5 (30.1 – 34.6)	34.6 (29.3 – 40)	33.8 (32.9 – 36)	^{H}<0.001	^{H}NS

SD: Standard deviation χ^2: Chi square test ; MC: Monte Carlo, F: F for One way ANOVA test. Pairwise comparison between each 2 groups was done using Post Hoc Test (Tukey). *p: p* value for comparing between the four studied groups, $p > 0.05$ is not significant (NS). p_1*: p* value for comparing between seropositive and seronegative CMV in cases group
RBCs: red blood cells, Hgb: hemoglobin, HCT: hematocrit, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration.

Table 3. The relation between different blood parameters and cytomegalovirus (CMV) seroprevalence in the two studied groups.

Parameter	Cases		Control		*p*	p_1
	Seronegative (n =23)	Seropositive (n =22)	Seronegative (n = 33)	Seropositive (n = 12)		
PLT Median (Min. – Max.)	252 (140 – 433)	216.5 (117 – 500)	260 (165 – 385)	213.5 (127– 780)	^{H}NS	^{H}NS
Thrombocytopenia						
No	21 (91.3%)	19 (86.4%)	33 (100%)	11 (91.7%)	^{MC}NS	^{FE}NS
Yes	2 (8.7%)	3 (13.6%)	0 (0%)	1 (8.3%)		
WBC Median (Min. – Max.)	6.8 (3 – 9.6)	6.5 (3.6 – 13.3)	6.9 (3.5 – 12.8)	8.3 (3.3 – 15.5)	^{H}NS	^{H}NS
Leucopenia						
No	20 (87%)	16 (72.7%)	32 (97%)	10 (83.3%)	^{MC}NS	^{FE}NS
Yes	3 (13%)	6 (27.3%)	1 (3%)	2 (16.7%)		
Neutrophils Median (Min. – Max.)	56 (33 – 74)	54.5 (28 – 75)	58 (40 – 79)	58 (34 – 81)	^{H}NS	^{H}NS
Lymphocytes Median (Min. – Max.)	27 (15 – 50)	30.5 (16 – 54)	35 (15 – 52)	33 (10 – 55)	^{H}NS	^{H}NS
Monocytes Median (Min. – Max.)	9 (6 – 16)	8 (4 – 15)	4 (2 – 9)	4.5 (2 – 6)	^{H}<0.001	^{H}NS
Eosinophils Median (Min. – Max.)	3 (1 – 36)	3 (1 – 18)	2 (1 – 5)	2 (1 – 7)	^{H}<0.001	^{H}NS

Table 3. Continued.

Parameter	Cases		Control		*p*	p_1
	Seronegative (n =23)	Seropositive (n =22)	Seronegative (n = 33)	Seropositive (n = 12)		
Basophils Median (Min. – Max.)	1 (0 – 2)	1 (0 – 2)	1 (0 – 1)	0 (0 – 1)	^{H}0.003	^{H}NS

MC: Monte Carlo. Pairwise comparison between each 2 groups was done using Post Hoc Test (Tukey). PLT: platelets, WBCs: white blood cells. *p: p* value for comparing between the four studied groups, $p > 0.05$ is not significant (NS). p_1*: p* value for comparing between seropositive and seronegative CMV in cases group.

A significant negative correlation was found between CMV-IgG and Hgb concentration in ESRD patients (r= -0.49, *p*=0.001) which means that the higher the titer of serum CMV-IgG, the lower Hgb concentration (Figure 2).

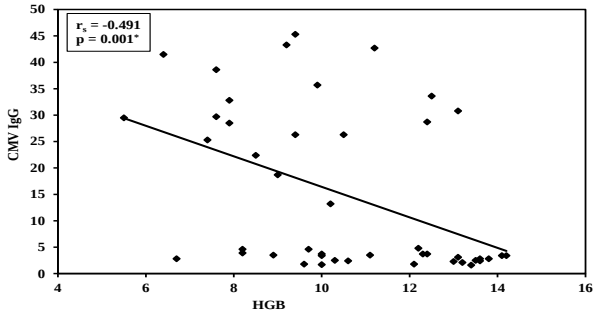

Figure 2. Scatter plot of cytomegalovirus (CMV) IgG versus hemoglobin (Hgb) concentration in the ESRD cases group.

Multivariate logistic regression analysis in ESRD patients showed that CMV-IgG seropositivity was a significant independent variable for the presence of anemia (OR 11.672, *p*= 0.008) (Table 4), while CMV-IgG and IgM seropositivity were insignificant independent variables for the presence of leucopenia or thrombocytopenia (Tables 5 and 6).

Table 4. Multivariate Logistic regression analysis model in end-stage renal disease (ESRD) patients using anemia as dependent variable.

Independent variables	B	SE	*p* value	OR	95% CI	
					LL	UL
CMV IgM seropositivity#	-1.627	1.332	NS	0.197	0.014	2.674
CMV IgG seropositivity #	2.457	0.930	0.008*	11.672	1.887	72.217

B: Unstandardized Coefficients SE: Estimates Standard error, OR: Odd`s ratio, C.I: Confidence interval, LL: Lower limit UL: Upper Limit, #: Adjusted by Erythropoietin treatment, Ferritin, Age (years), sex and comorbidities,
* $p > 0.05$ is not significant (NS).

Table 5. Multivariate Logistic regression analysis model in end-stage renal disease (ESRD) patients using leucopenia as dependent variable.

Independent variables	B	SE	*p value	OR	95% CI	
					LL	UL
CMV IgM seropositivity #	-19.537	21256.822	NS	0.0	0.0	–
CMV IgG seropositivity #	1.629	0.906	NS	5.098	0.863	30.116

B: Unstandardized Coefficients, SE: Estimates Standard error, OR: Odd`s ratio, C.I: Confidence interval, LL: Lower limit UL: Upper Limit, #: Adjusted by Age (years), sex and comorbidities, * $p > 0.05$ is not significant (NS).

Table 6. Multivariate Logistic regression analysis model in end-stage renal disease (ESRD) patients using thrombocytopenia as dependent variable.

Independent variables	B	SE	*p* value	OR	95% CI	
					LL	UL
CMV IgM seropositivity #	2.443	1.764	NS	11.502	0.362	365.348
CMV IgG seropositivity #	0.148	1.037	NS	1.159	0.152	8.855

B: Unstandardized Coefficients SE: Estimates Standard error OR: Odd`s ratio C.I: Confidence interval
LL: Lower limit UL: Upper Limit, #: Adjusted by Age (years), sex and comorbidities. * $p > 0.05$ is not significant (NS).

Discussion

Chronic kidney disease (CKD) and ESRD are significant global public health issues that lead to high rates of illness and death, particularly in developing countries such as Egypt. The cost of care for hemodialysis is a major burden in these regions.[13] Anemia is a feature of CKD, ESRD and a complication in renal transplantation, often caused by impaired production of erythropoietin.[14]

A well-known risk factor for considerably raising the morbidity and mortality rates among ESRD patients and kidney transplant recipients is human CMV infection. The kidney is a target organ for human CMV, and human kidney cells of glomerular, vascular, and tubular origin are susceptible to infection. Renal allografts can include human CMV DNA and proteins, and infection has been linked to severe anemia, but it is not known whether the CMV affects erythropoietin production.[15]

Consequently, this study aimed to examine the impact of CMV infection on various blood parameters in patients with ESRD, with the goal of improving laboratory and clinical outcomes in ESRD patients along with reducing the morbidity and mortality associated with dialysis.

Anemia is defined as Hgb level ≤ 12 g/dL in women and ≤ 13 g/dL in men, in accordance with World Health Organization (WHO) criteria.[12]

In this study, we found that about 62.2% of the ESRD patients and only 24.4% of the control group were presented with anemia with statistically significant difference (p <0.001). A higher prevalence of anemia among CKD patients was reported from studies in Ethiopia (85.33 %)[16] and India (87 %).[17] Moreover, we have shown that the hematological profile of ESRD patients as mean RBCs, Hgb concentration, percentage hematocrit, MCH, MCHC were substantially reduced in ESRD patients as compared to the control group. Another study conducted in Africa showed the same results.[18]

In our study, moderate anemia was the main pattern of anemia in ESRD patients which is in accordance with a study from Ethiopia.[16] Our study and numerous other studies[16-17, 19] have shown that the severity of anemia increases with disease progression. In the current study, we showed that CMV seropositivity worsens anemia in ESRD patients probably due to reduction of erythropoietin secretion as the main pathophysiological factors of anemia in ESRD.

Leucopenia and thrombocytopenia were present in 20 % and 11.1 %, respectively in the ESRD patients and in 6.7 % and 2.2 %, respectively of the control group with no statistically significant differences. Another study conducted in 2006, by Cooke and his colleagues[20] revealed that the CMV itself, its mutations, or other viral-host interactions have contributed to the decline in WBC.

In our study, neutrophils, monocytes, lymphocytes, eosinophils and basophils, are the leukocyte populations that were decreased with CMV seropositivity. The pathobiology of human CMV, which includes the evolution of mechanisms for avoiding detection by the host immune system, is consistent with these observations.

The decline in neutrophils and monocytes in this study may be due to CMV's effect. Importantly, it might explain the immunosuppressive condition that is frequently described in the context of CMV infection in recipients of solid organ transplants as described in the study of Yamani et al., 2001.[21]

In the current study, the seroprevalence of CMV infection was 48.9% in the hemodialysis

patients, but significantly lower (26.7%) in the control group (p=0.030). Between 2013 and 2017; Rezzouk et al., 2021, enrolled 60 post-renal allograft patients who were taking post-transplant prophylaxis and had a positive CMV serostatus. Patients who tested positive for CMV had a 63% infection rate, which is a little higher than in the current study.[22] Another study from Iraq showed that the seroprevalence of CMV infection among hemodialysis patients was 75% [23]. Several factors contribute to this variation between study findings, including the endemicity of the virus, public health, patient immunity, environmental factors, geographic location, and changes in the assay methods used to detect CMV.[24]

In this study, the seroprevalence rate of CMV-IgG antibodies (42.2%) in ESRD patients was greater than that of CMV-IgM antibodies (6.7%). In a study from Turkey, seropositivity for CMV-IgM and CMV-IgG antibodies was 0.4 % and 99.6 %, respectively in the hemodialysis patients.[25] Similarly, in Morocco a study by Ghita et al., 2021, revealed that the prevalence of IgG and IgM anti-CMV was 98% and 0.6% respectively.[26] Another study from Iran showed that the seroprevalence of CMV IgG and IgM antibodies in hemodialysis patients was 88.7 % and 10.9 %, respectively,[27] while a study from Brazil revealed 4.9% and 96% seropositivity for CMV-IgM and CMV-IgG antibodies, respectively.[28]

The increase in CMV IgG antibodies in hemodialysis patients suggests a prior infection or reactivation of the CMV virus, while a primary, recent, or ongoing CMV infection is frequently confirmed by the presence of CMV-IgM antibodies. After infecting mononuclear cells first, the virus remains dormant and frequently contributes to the development of large cells, which increases the risk of CMV infection.[29]

In this study, multivariate logistic regression analysis showed that CMV-IgG seropositivity was a significant independent variable for the presence of anemia (OR 11.672, p= 0.008). This is in agreement with another study that found renal human CMV infection could induce or exacerbate anemia in patients.[30] However, our study demonstrated that CMV-IgG and CMV-IgM seropositivity were not significant independent predictors for the presence of leucopenia or thrombocytopenia in ESRD patients. In the study by Kaze et al., 2020, leucopenia affected 15% of patients, and thrombocytopenia affected nearly one in four. The authors discussed the prevalence of leucopenia in these high-risk patients as being related to the infectious environment.[31]

According to a previous report, patients receiving hemodialysis in renal failure units had a significant frequency of CMV infection. The authors linked this increase to patients receiving therapeutic medications, which increased their risk of CMV infection.[32] Moreover, frequent blood transfusions and compromised immunological responses brought on by T cells releasing fewer inflammatory cytokines, make these individuals more vulnerable to CMV reactivation.[33]

Limitations and strengths of the present study include the small sample size of this retrospective study which limits the power of statistical testing to detect risk factors. Secondly, this was a single-center study that may have limited the applicability of our findings. Third, we did not run any tests to check the immunity to CMV. Lastly the study lacks quantitative information on CMV viral load and timing of CMV infection during the first year, which makes it difficult to understand how other problems are impacted by CMV. However, the advantage of this study is that it contained a representative group of ESRD patients who tested positive for antibodies and all measurements were expressed in terms of international standard units. To lower the frequency of CMV infection, we advocate routine CMV testing for blood donors and dialysis unit employees, much as human immunodeficiency viruses and hepatitis viruses (HBV and HCV) testing is advised. The results of our study are useful because full blood count analyses are performed frequently which are reasonably priced when severe conditions are considered. African and other low- and middle-income countries often have resource-constrained environments making these tests a good choice to follow up ESRD patients.

In conclusion, CMV infection is a significant concern for dialysis patients and can affect hematological parameters, leading to further complications. Early detection and treatment of CMV infection and monitoring of CMV IgM and IgG levels are critical to prevent further complications and improve clinical outcomes.

Author Contributions

All authors contributed equally in this work including the collection of samples, laboratory work, manuscript writing, statistical analysis and paper supervision. All authors revised and approved the published version of the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical approval

The study protocol was reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Suez Canal University (Research 5339**#**, dated June 2023).

Informed consent

A written informed consent was obtained from each individual who participated in the study before included in the study..

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