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Serum IgG antibody against human cytomegalovirus in HIV-infected patients presenting at a tertiary hospital in Port Harcourt, Nigeria

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Abstract

Human Cytomegalovirus (HCMV) infection goes unnoticed in most clinical settings, despite the fact that it can lead to more serious conditions, particularly in immunocompromised patients. Having understood the mortality of HCMV mostly in immunocompromised patients, this study sought to find out the current burden of HCMV among HIV infected patients in Port Harcourt, Nigeria. A total of 93 HIV-infected patients enrolled in this study and their blood samples were analysed for the presence of HCMV IgG using ELISA techniques. Of the 93 HIV positive participants, 92(98.9%) tested positive for HCMV IgG antibodies while 1(1.1%) was negative. All the participants within the ages 9-20, 21-40 and 61-80 years were positive for HCMV IgG (100.0%) while those within ages 41-60 years had lesser seropositivity (96.1%). Males, singles, unemployed, civil servant, traders and artisans had the highest HCMV exposure (100.0%) compared to other categories. However, age, sex, marital status, educational background, occupation and religion were not statistically associated ($p>0.05$) with HCMV serostatus. The high prevalence of 98.9% of HCMV IgG showed that HIV patients were at high risk of HCMV coinfection. This study shows that human cytomegalovirus IgG is high among HIV infected patients in Port Harcourt, Nigeria. Based on the high prevalence recorded in this study, there is need to routinely screen for HCMV coinfection among HIV-infected patients in order to prevent end organ disease.

Keywords: Antibody; HCMV; IgG; HIV; Patients; Nigeria

1. introduction

Since its discovery, human cytomegalovirus (CMV) infection has become a significant public health issue on a global scale (Mangare et al., 2018). Prior to the development of highly active antiretroviral therapy (HAART), it was a main source of serious opportunistic infections in HIV-infected patients. It is a prevalent infection among people with HIV (Adeiza & Habib, 2019; Cheung & Teich, 1999; Edwin et al., 2021; Udeze et al., 2018). After the introduction of HAART, which increased HIV-infected people's survival rates, its role in morbidity and mortality became increasingly obvious (Udeze et al., 2018).

It is a common virus that affects people of all ages, genders, and races is HCMV (Mangare et al., 2018). End-organ disorders (EODs), such as retinitis, are linked to HCMV viraemia, which denotes an active infection (Edwin et al., 2021). It establishes a latent stage after primary infection and reactivates when the immune status changes (Abubakar & Adamu, 2021). It is a paradoxical virus that has the capacity to kill or serve as a silent lifetime ally (Abubakar & Adamu, 2021).

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Disease symptoms are rare in immunocompetent people because HCMV lives in a symbiotic balance with them (Griffiths & Emery, 1997). However, HCMV manifests its full pathogenic potential in immunocompromised individuals, such as HIV patients, newborns, or by iatrogenic ways after organ transplantation (Mocarski, 1993). A compromised immune system results from the infection of CD4 T-Helper cells by the human immunodeficiency virus, which controls humoral and cellular immunity (Cheesbrough, 2005). Following primary infection, HCMV disperses and becomes dormant in a number of organs. As in HIV patients, immunosuppression causes HCMV to reactivate (Hummel & Abecassis, 2002). As a result, HCMV infection is a typical opportunistic viral infection (Abubakar & Adamu, 2021). The morbidity and mortality of HIV illness are worsened by a co-infection with HCMV (Anigilaje et al., 2015).

Mocarski et al. (2007) claim that there is a significant burden of HCMV worldwide. According to serological surveys, almost all populations examined had HCMV infections (Okwori et al., 2008), with seropositivity rates varying from 40 to 100% globally (Seferi et al., 2009; Matos et al., 2010; Yeroh et al., 2015). Estimates ranging from 36.0% to 77.0% have been reported in the United States, Australia, and Europe (Adland et al., 2015). Israel, France, Belgium, Spain, Italy, Germany, Austria, Portugal, and the Netherlands have similarly observed lower HCMV prevalence (Forsgren, 2009).

The highest seroprevalence of HCMV IgG antibodies, according to Hamdan et al. (2011), was found on the African continent, with rates of 97.2% in Benin (Rodier et al., 1995), 96.0% in Egypt, 77.3% in Kenya (Maingi & Nyamache, 2014), and 72.2% in Western Sudan (Hamdan et al., 2011). HIV seroprevalence rates in Nigeria were 100% (Akinbami et al., 2010), 93.9% (Fowotade et al., 2015), 77% (Nassarawa state) (Ahmed, 2016), and 73.6% (Offa Kwara) according to a serological survey of HIV-positive individuals (Udeze et al., 2018).

This study looked at how often people with HIV/AIDS who visited the retroviral clinic at the Rivers State University Teaching Hospital (RSUTH) in Port Harcourt, Rivers State, Nigeria, had serum IgG antibodies against human cytomegalovirus.

2. Material and methods

2.1 Study Area

This investigation was conducted by enrolling patients attending the Braithwaite Memorial Specialist Hospital (BMSH). The Braithwaite Memorial Specialist Hospital (BMSH), presently known as the Rivers State University Teaching Hospital (RSUTH). It is a government-owned hospital that bears the name Eldered Curwen Braithwaite in honor of the pioneering British surgeon. It is situated in Rivers State's Old GRA and run by the hospital's management board.

It was first used as a medical center for senior civil workers when it opened in March 1925 as Braithwaite Memorial Hospital. Later, it changed its name to a general hospital, and today it is known as a "Specialist Health Institution." Following the creation of the faculty of medical science, it was renamed to serve as a Teaching Hospital for the state-owned university in 2018. The Rivers State University Teaching Hospital (RSUTH) is one of the largest hospitals in the Niger Delta and has received formal recognition from the Federal Ministry of Health. The clinic has 731 medical staff members and 375 licensed beds.

2.2 Study Design

This study was a cross-sectional, hospital-based cohort study which sought to detect human cytomegalovirus IgG antibody among HIV patients attending Rivers State University Teaching Hospital (RSUTH), Rivers state, Nigeria.

2.3 Eligibility Criteria

Before being enrolled, participants were required to have agreed to participating in the study by signing a consent form, willing to provide blood sample for the study and be re-tested for HIV to confirm their HIV seropositivity status. Those who did not consent to the above were excluded from the process.

2.4 Study Population

The target population constituted patients attending the retroviral clinic in Rivers State Teaching Hospital (RSUTH) for routine checkup who willingly gave their consent and volunteered to have their blood samples tested for HIV positive. For the study population, a total sample size of 93 HIV infected individuals were randomly selected and enrolled in the study.

2.5 Sample Collection and Processing

The method of sample collection employed was venipuncture techniques, 3ml of blood sample was transferred into a plain (non-anticoagulant) container. The samples were centrifuged at 3000rmp (resolution per minute) for 5 minutes and then the serum was obtained and aspirated into new Eppendorf tubes, and appropriately labelled. Serum samples were transported in cold chain to the Virus and Genomics Unit, Department of Microbiology, University of Port Harcourt for further laboratory analysis and stored at −20°C until assayed.

2.6 Laboratory Analysis of HCMV IgG Antibody

Enzyme-linked immunosorbent assay (ELISA) Dia.Pro, Milano, Italy was used in the laboratory to analyze the samples and evaluate the presence of HCMV IgG antibodies. Using an ELISA reader, the outcome was read at 450 and 630 nm wavelengths. The manufacturer's instructions were followed throughout each analysis. For anti-human cytomegalovirus IgG antibody, samples with a concentration less than 0.5WHO IU/ml were regarded as negative, whereas samples with a concentration greater than 0.5WHO IU/ml were regarded as positive.

2.7 Data Analysis

Data was analyzed using the Statistical Package for Social Science (SPSS) version 22.0. The prevalence for HCMV was expressed as a percentage. Chi square or Fisher's exact was used where appropriate to test association. A p value of <0.05 was considered significant.

3. Results

3.1 Participant Demographic Variables

The total participants recruited for this study were 93 who gave their consent to this study. Table 1 shows their demographic characteristics. Female constituted much of the study population (54.8%) while (45.2%) were males. Out of the total participants three (3) were below the age of 20 years while ninety (90) were above 20years old. Participants were in the following age groups; 9-20years (n=3, 3.2%), 21-40years (n=62, 66.7%), 41-60years (n=26, 27.9%) and 61-80years (n=2, 2.2%).

Majority (53.8%) of the participants were married, followed by those that were single (35.5%) while a minority (10.8%) of the participants were divorced or widowed. The highest (36.5%) number of the participants had attained only primary education while (16.1%) had no formal education, 25.8% had a secondary education and 21.5% had a tertiary education. Students constituted most of the participants with (32.2%), while the artisans (8.6%) were the minority. About 21.5% of the participants were unemployed, 19.4% were traders, and 18.3% were civil servants.

3.2 Prevalence of human Cytomegalovirus (HCMV) IgG in relation to the sociodemographic variables of participants

Out of the total number of 93 HIV positive participants registered under the study, 92(98.9%) of them tested positive for HCMV IgG antibodies while 1(1.1%) was negative as shown in Table 1. While all those within the ages 9-20, 21-40 and 61-80 years were positive for HCMV IgG (100.0%), 96.1% of those within ages 41-60 years were positive. Males had HCMV IgG seroprevalence of 100.0% while females had a seroprevalence of 98.0%. HIV patients without any form of education, and those with primary and tertiary education had 100.0% exposure to HCMV while HIV patients with secondary education had 95.8% seroprevalence.

With respect to their marital status, all the patients that were single and divorced or separated tested positive, while 98% of those that were married were positive. A 100% HCMV exposure was observed for HIV patients that were unemployed, civil servants, traders and artisans while students had a 96.6% exposure to HCMV IgG. None of the demographic characteristics of the patients showed a statistically significant association with HCMV serostatus.

Table 1 Prevalence of HCMV IgG in relation with sociodemographic Characteristics of HIV Infected Participants

Variables	No. Tested (%)	No. Positive (%)	Chi-square Analysis
Age groups			
9-20	3 (3.2)	3(100.0)	X^2 = 2.604, df=3, p=0.46
21-40	62 (66.7)	62(100.0)	
41-60	26(27.9)	25(96.1)	
61-80	2(2.2)	2(100.0)	
Gender			
Males	42(45.2)	42(100.0)	X^2 =0.83, df=1, p=0.36
Females	51(54.8)	50(98.0)	
Marital status			
Singles	33(35.5)	33(100.0)	X^2 = 0.87, df=2, p=0.65
Married	50(53.8)	49(98.0)	
Divorced/widowed	10(10.7)	10(100.0)	
Education			
None	15(16.1)	15(100.0)	X^2 = 2.91, df=3, p=0.41
Primary	34 (36.6)	34(100.0)	
Secondary	24(25.8)	23(95.8)	
Tertiary	20(21.5)	20(100.0)	
Occupation			
Students	30(32.2)	29(96.6)	X^2 = 1.86, df=3, p=0.603
Unemployed	20(21.5)	20(100.0)	
Civil servants	17(18.3)	17(100.0)	
Trading/Business	18(19.4)	18(100.0)	
Artisans	8(8.6)	8(100.0)	
Religion			
Christianity	81(87.1)	80(98.8)	X^2 = 0.15, df=1, p=0.69
Islam	12(12.9)	12(100.0)	
Total	93(100.0)	92(98.9)	

4. Discussion

Although it can result in more serious problems, especially in patients with impaired immune systems, human cytomegalovirus (HCMV) infection is frequently overlooked in clinical settings. It suppresses the immune system when HIV infection is present. Analyzing how the co-infection affects the immune system becomes important. Determining the current HCMV load among HIV-infected patients at Rivers State University Teaching Hospital was the aim of this investigation. Of the 93 HIV-infected individuals analysed, 98.8% had HCMV IgG antibody.

In Port Harcourt, Rivers State, a cohort of HIV-infected individuals was found to have a high HCMV IgG seroprevalence of 98.8%, which is remarkable and represents the amount of overall infection burden within this cohort of HIV-infected patients. This demonstrated the high probability of HCMV coinfection among HIV patients (Maingi & Nyamache, 2014). This finding is similar to those of Akinbami et al. (2010) who discovered 100.0% CMV seroprevalence among HIV

patients in Nigeria and Chakraborty et al. (2003) who discovered 100.0% seroprevalence among HIV-1-infected street children at Nyumbani Children's Home in Kenya (Chakraborty et al., 2003). Additionally, it is comparable to previous reports from Africa, including those from Benin (97.2%) (Rodier et al., 1995) and Egypt (96.0%) (el-Nawawy et al.,1996). However, it is higher than the 91.0% reported in our earlier study among pregnant women in Port Harcourt, Nigeria (Okonko et al., 2022).

This prevalence percentage is a little greater than that which other researchers from various regions of Nigeria have reported. In Ilorin, 93.9% of HIV patients had seroprevalence, according to Fowotade et al. (2015). In Benue State, CMV IgG seroprevalence was found to be 93.3% in 2015 by Umeh et al. The National Blood Transfusion Center observed 93.0% seroprevalence among healthy blood donors in a similar study by Njeru et al. (2009). In Nasarawa State, Pennap and Ahmed (2016) showed 77% HCMV IgG antibody level, whereas Adeiza et al. (2016) discovered 86.0% seroprevalence. Udeze et al. (2018) recorded 73.6% prevalence for HCMV IgG antibodies recorded among HIV infected patients in Offa Kwara. In Maiduguri, Borno state, and Benin, Edo state, comparable higher prevalence rates for HCMV IgG antibodies have been found among HIV patients (Ojide et al., 2013; Kida et al., 2014).

This high percentage is probably due to frequent blood transfusions and poor hygienic habits, such as sharing saliva or drinking from the same vessel or sharing drinks. The high seroprevalence found in this study may possibly be related to people's inadequate knowledge of hygiene and preventative practices, which may be the main contributing factor to the high rates of HCMV infection and transmission (Colugnati et al., 2007).

In other countries outside of Kenya, seroprevalences of 90.0%–100.0% have been reported in India (Madhavan et al., 1974; Kothari et al., 2002), 89.0% by Mangare et al. (2018), 77.3% by Maingi & Nyamache (2014), 87.0% by Bello and Whittle (1991) in the Gambia, 87.0% by Mhalu and Haukenes

It is possible that the varied forms of HIV infection are to blame for the high prevalence rate of human cytomegalovirus (HCMV) in both this study and other research conducted in African nations (Fabiani et al., 2006). The high incidence of HCMV may be attributed to sociodemographic factors, varied cultures, population behavior, childcare, nursing, sexual activities, saliva sharing (mainly drinking from the same vessel), and direct contact with contagious secretions from the environment (Peckham et al., 1987).

The prevalence rates in industrialized nations, where prevalence ranges from 38.0% to 75.0%, are lower than those in Nigeria and other emerging nations like Kenya and India. Between 36.0% and 77.0% of adult populations in the United States, Australia, and Europe are séropositive (Adland et al., 2015). Pregnant women in France obtained 46.8% of the total (Picone et al., 2009). The observed high cleanliness standards and practices may be the cause of the significantly lower frequency in developed nations. Pregnant women were routinely examined for HCMV in Israel and eight European nations (France, Belgium, Spain, Italy, Germany, Austria, Portugal, and the Netherlands) with low HCMV prevalence (Forsgren, 2009).

Contrary to earlier reports, analysis of the results by age showed that there was no significant correlation between HCMV and age (Okwori et al., 2008; Stadler et al., 2012; Yeroh et al., 2015). In all age groups, there was a very high seroprevalence. Young people (21–40 years) and teenagers (9–20 years) are more likely to participate in risky behaviors that could increase the rate of transmission. This observation agrees with the findings in our previous studies in Port Harcourt, Nigeria (Okonko et al., 2022). In that study, we reported that age-specific HCMV IgG seropositivity rate was highest (41.0%) among females aged 26-31 (Okonko et al., 2022). Since the virus maintains latency in the body and an infected person is infected for life, the cumulative nature of the infection is demonstrated by the high frequency of HCMV IgG antibody found in elderly individuals (61-80 years) with a 100.0% rate. Both Fowotade et al. (2015) and Udeze et al. (2015) reported on a similar trend (2018).

Additionally, the study discovered that male patients had a greater rate of prior HCMV infection (100.0%) than their female counterparts (98.0%). This distinction is not, however, statistically significant ($p > 0.05$). This is consistent with research by Fowotade et al. (2015), Ojide et al. (2013), and Udeze et al. (2018), which found no link between HCMV-specific IgG antibodies and gender.

Although not statistically significant ($p>0.05$), patients who are single, divorced, or widowed are marginally more likely to have anti-HCMV IgG antibodies than patients who are married (98.0%). On the other hand, the study of Fowotade et al. (2015) discovered a strong correlation in the distribution of HCMV IgG antibody among various marital groupings. In our previous study among pregnant women, we reported that the highest prevalence was observed in married women than in singles in Port Harcourt, Nigeria (Okonko et al., 2022).

Additionally, there were no distinct educational characteristics in the seroprevalence rate of HCMV. The patients in this group with secondary education had the lowest frequency of HCMV IgG antibody (95.8%), whereas those with primary, tertiary, and no education had the highest prevalence (100.0%). This agrees favorably the findings of our previous study in Port Harcourt, Nigeria (Okonko et al., 2022) which revealed that the prevalence of HCMV IgG antibody was higher with tertiary education than their counterparts with other educational level. Contradicting this, is a study by Hamdan et al. (2011) that found illiterates had a higher risk of contracting HCMV due to contact with contagious secretions and poor hygiene habits.

HCMV infection risk has been associated with socioeconomic level (Brooks et al., 2007). This is most likely because people with higher socioeconomic position are more likely to be able to afford better and healthier living conditions and pursue an education, which minimizes exposure to the virus. However, our results showed that there was no correlation between the patients' occupation and anti-HCMV IgG antibody level ($p > 0.05$). Among this cohort, the prevalence of HCMV IgG antibodies was lowest in the student population (96.6%), whereas IgG antibody levels were highest in the jobless, public servants, traders/business owners, and craftsmen (100%). Similar research by Umeh et al. (2015) and Fowotade et al. (2015) among HIV-positive patients and pregnant women, respectively, did not discover any statistically significant correlation between the distribution of anti-HCMV IgG antibodies and individuals' levels of education. In our previous study in Port Harcourt, Nigeria (Okonko et al., 2022), it was revealed that the prevalence of HCMV IgG antibody was higher among homemakers than their counterparts with other occupational status. Summarily, there was no statistically significant relationship between HCMV serostatus and age, sex, marital status, educational attainment, occupation, or religion ($p>0.05$). This observation is different from that made in Nigeria by Kolawole and Oluwajana (2017).

5. Conclusion

This study has demonstrated that HIV-infected patients at the Rivers State University Teaching Hospital in Port Harcourt, Nigeria, had significant levels of human cytomegalovirus (HCMV) IgG. Cytomegalovirus can further depress the immune system in HIV patients. In order to prevent end organ damage, it is now required to routinely test HIV-infected patients for HCMV coinfection. Human cytomegalovirus risk factors, transmission, and prevention are all key topics to cover, as are ways to boost HIV-infected people's immunity.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

Authors have declared that no competing interests exist.

Statement of ethical approval

All authors hereby declare that all experiments have been examined and approved by the University of Port Harcourt and Rivers State University Teaching Hospital Research Ethics committees and have, therefore, been performed following the ethical standards laid down in the 1964 Declaration of Helsinki.

Statement of informed consent

All authors declare that informed consent was obtained from all individual participants included in the study.

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