East African Medical Journal Vol. 86 (Supplement) December 2009
PREVALENCE OF CYTOMEGALOVIRUS ANTIBODIES IN BLOOD DONORS AT THE NATIONAL BLOOD TRANSFUSION CENTRE, NAIROBI
D. G. Njeru, MBChB, MMed (Path), Dip. Forensic Med (SA), Registrar, Department of Human Pathology, W. O. Mwanda, MBChB, FRCPath UK (Associate), MD, Associate Professor, G. W. Kitonyi, MBChB, FRCPath (UK), Senior Lecturer, Haematology and Blood Transfusion Unit, Department of Human Pathology and E. C. Njagi, MBChB, MSc (Immun) UK, Lecturer,Thematic Unit of Immunology, Department of Human Pathology, School of Medicine, University of Nairobi, P. O. Box 19676 - 00202, Nairobi, Kenya

Request for reprints to: Dr. D. G. Njeru, P. O. Box 19958, 00202, Nairobi, Kenya

PREVALENCE OF CYTOMEGALOVIRUS ANTIBODIES IN BLOOD DONORS AT THE NATIONAL BLOOD TRANSFUSION CENTRE, NAIROBI

D. G. NJERU, W. O. MWANDA, G.W. KITONYI and E. C. NJAGI

ABSTRACT

Background: **Cytomegalovirus (CMV) infection in susceptible patients is associated with serious morbidity and a high mortality. Transmission of cytomegalovirus infection through blood transfusion is markedly reduced by transfusion of CMV seronegative blood products, or by transfusion of leucodepleted blood products.**
Objective: **To determine the prevalence CMV IgG and IgM antibodies among blood donors at the National Blood Transfusion Services (NBTS), Nairobi.**
Design: **Cross-sectional descriptive study.**
Setting: **Four hundred participants were recruited from blood donors at the NBTS and testing was done at the Kenyatta National Hospital (KNH) immunology laboratories and the NBTC.**
Main outcome measures: **Social demographic data and the CMV serologic status for the participants was determined and documented as being positive or negative for immunoglobulin G (IgG) and immunoglobulin M (IgM). The age, gender, marital status, education level and geographical area of residence of the participants were documented. Corresponding results of HIV, hepatitis B antigen, hepatitis C antibody from the patients were obtained from the NBTS.**
Results: **Majority of the blood donors recruited were male at 57.9%. Most blood donors were aged 16-20 years (42.5%) and only 17.2% were above 30 years of age. Unmarried blood donors, those with secondary school education and an income between Kshs 5,000 (US$ 67)and KShs 50,000 (US$ 667) monthly were the majority at 78.5%, 54.8% and 66.1% respectively. Sexually active blood donors constituted 60.5% of the donors recruited. Positivity for transfusion transmissible infections (TTI) tested was 1.3%, 0.3%, 2.3% and 1.0% for human immunodeficiency virus (HIV), syphilis, hepatitis B and hepatitis C respectively. Anti- CMV IgG and IgM positivity was 97.0%,(95% CI 96.45-97.53%), and 3.6% (95% CI 1.7-5.2%), respectively. There was no statistical difference between different ages, marital status, salary, individual's sexuality in the prevalence of CMV antibodies. However females had a higher prevalence of CMV antibodies.**
Conclusion: **There is a very high prevalence of cytomegalovirus antibodies among blood donors at the NBTS, with virtually all blood donors having been exposed to the virus. Since the CMV remains latent within leucocytes after infection inspite of the prescence of antibodies in seropositive individuals, leucoreduction of blood products is recommended before transfusion to seronegative susceptible patients. In Kenya, susceptible groups of patients include very low birthweight babies, patients with acquired immune deficiency syndrome (AIDS) due to human immunodeficiency virus infections (HIV) patients, patients on myelosuppressive cancer therapy and recipients of kidney transplants. Further studies are recomended to determine the prevalence of CMV antibodies in these patients in order to establish the magnitude of the demand for CMV safe blood.**

INTRODUCTION

Cytomegalvirus (CMV) is a double stranded DNA virus that is found throughout the world in all geographical locations and socio-economic groups. It infects between 50% and 85% of all adults in the developed world by the age of 40 years (1,2). The rate of seropositivity increases with age and decreasing socio-economic status (2-4). Immune response does not eliminate the virus but the virus remains latent in leucocytes and can be transmitted through blood or blood products to a recipient of these products. CMV safe blood or blood products are obtained from CMV seronegative individuals, or leucoreduced blood products before transfusion (5-7).

In healthy subjects, infection with the CMV virus is often subclinical but may occasionally manifest with a mild self limited disease with fever, malaise, hepatosplenomegaly and rash (1). In susceptible patients who include low birth weight babies, HIV/AIDS patients, patients on myelosuppressive cancer therapy and recipients of organ and haemopoetic cell transplants, CMV infections is associated with serious morbidity and a high mortality rate. Infection may result in hepatitis, retinitis, and multisystem failure (8-11). Susceptible patients should therefore receive CMV safe blood products, which should either be CMV seronegative or leucoreduced (12-14).

Currently in most resource constrained developing countries, including Kenya, CMV safe blood is not yet available in the blood transfusion service despite the fact that there is a significant proportion of patients who require the product. The prevalence of CMV antibodies in Kenyan blood donor population is unknown. Prevalence of CMV virus seropositivity among donors is important because it indicates the pool of the potential source of CMV seronegative donors. This study aims at determining the prevalence of CMV IgG and IgM antibodies in blood donors at the NBTS, Nairobi.

MATERIALS AND METHODS

Study population and setting: This cross-sectional descriptive study was carried out at the NBTS and the immunology department, KNH. The laboratory testing for anti-CMV antibodies was done at the KNH immunology laboratories while that for the other transfusion transmittable infections, (TTI- HIV, VDRL hepatitis B and hepatitis C), were carried out routinely at the NBTS laboratory. The study was carried out on 400 blood donors, who met the criteria for blood donation set by the NBTS and were recruited by simple random sampling at the various NBTC blood collection sessions. These blood donors included students from different institutions such as secondary schools and colleges within Nairobi province. They also included the general public recruited in towns, hotels and churches in the areas covered by the NBTS. Social demographic data including age, sex, marital status, level of income and sexuality were obtained from consenting individuals and recorded.

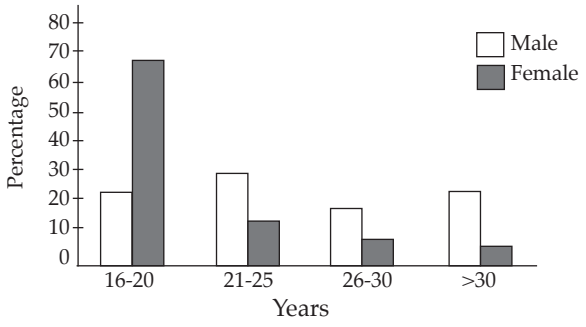
Specimen collection, transport, storage and testing: Approximately 3mls of blood was drawn from each study participant into labelled vacutainer tubes and transported in cool boxes to the KNH immunology laboratories where they were tested for CMV-specific IgG and IgM antibodies by an Elisa method. The results were reported as positive or negative. Results of HIV screening, hepatitis B surface antigen, hepatitis C antibody, and syphilis testing were also recorded.

Data management: The data was entered into a pre-designed proforma, coded and entered into the statistical package for social sciences (SPSS), version 15. Descriptive statistics were applied to continuous and categorical data and proportions obtained. For precision 95% confidence intervals were applied. A p –value of less than 0.05 was considered significant. Data was presented in tables and figures.

RESULTS

Figure 1 summarises the age and sex distribution of the participants. There was a higher proportion of male donors than females. Most of the donors were young with a mean age of 24.2 years and median of 22 years. The age range was 16 to 54 years.

Figure 1
Age and gender distribution of the study participants



Majority of the participants, 382 (97% with 95% CI 96.45-97.53%) had CMV IgG antibodies. Only 14 (3.6% with 95% CI 1.7-5.2%) were CMV IgM antibody positive. Table 1 summarises CMV positivity among different age groups while Table 2 shows frequency of seropositivity among two genders.

Table 1
Anti-CMV antibodies and age of study participants

Age group	IgG				IgM			
	Positive		Negative		Positive		Negative	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
16 – 20	163	97.0	5	3.0	5	3.0	163	97.0
21 – 25	92	95.8	4	4.2	2	2.1	94	97.9
26 – 30	56	98.2	1	1.8	2	3.5	55	96.5
>30	66	97.1	2	2.9	5	7.4	63	92.6
Total	377	96.9	12	3.1	14	3.6	375	96.4

Table 2
Anti-CMV antibodies and gender

Gender		Male		Female		Total	
		No.	(%)	No.	(%)	No.	(%)
IgG	Positive	217	95.2	166	99.4	382	97
	Negative	11	4.8	1	0.6	12	3
IgM	Positive	8	3.5	6	3.6	14	3.6
	Negative	220	96.5	160	96.4	380	96.4

Five (1.3%) participants were HIV positive whereas 390(98.7%) were HIV negative. One (0.3%) donor tested positive for syphilis and 394(99.7%) tested negative. Nine (2.3%) participants were positive for hepatitis B and 386(97.1%) were negative while four (1.0%) tested positive for hepatitis C and 391(99%) tested negative. Three hundred and eighty three (97%-95%CI 96.45-97.53) participants were positive for IgG anti-CMV antibodies and 12(3%) were negative while 14(3.5%-CI 1.7-5.2%) tested positive for IgM anti-CMV antibodies and 381(96.5%) tested negative.

DISCUSSION

The results of this study are very similar to those of an Indian study by Kothari *et al* (17). They found very high prevalence of CMV IgG antibodies of 95% with very low IgM antibodies prevalence (17). This is in contrast to the lower levels in Western developed countries (1,2). This could be associated with broad socioeconomic factors (3). In this study however there were no significant differences in the prevalence with respect to education level, socioeconomic groups, marital status, sexuality, as demonstrated by other studies. The reason for this is not clear.

No statistically significant differences were found among different age groups. This study however did not include participants below 16 years of age because they are below the age limit for blood donation. It is recommended that studies below this age be conducted to determine the pattern of seroconversion in children.

A higher prevalence of CMV antibodies is noted in females which is consistent with other studies. The reason for the higher prevalence has been thought to be related to sexual transmission.

It has been argued that CMV IgM positive blood is more infective than IgG positive blood (3). The prevalence of CMV IgM only positivity is so low that in our setting it would be unaffordable to use IGM seronegative donors. Virtually all the donors are IgG positive and therefore potentially harbour CMV virus in a latent form in their leucocytes. It is therefore proposed that CMV safe blood should be obtained by leucoreduction, rather than by serotesting for CMV antibodies, for Kenyan susceptible patients. In Kenya the susceptible groups include low birth weight babies, HIV/AIDS immune compromised patients, patients on myeosuppressive cancer therapy and patients undergoing organ transplants.

ACKNOWLEDGEMENTS

To Dr. J. Nyamongo, (former director NBTC), and the Staff of NBTC who assisted during the study period and to the staff of immunology unit of the Department of Pathology for their assistance.

REFERENCES

1. Fredrick, R.A., Gordon, L.A., Nicholas, J.B., *et al*. Cytomegalovirus. In: Dennis, L.K., Eugene, B., Anthony, S.F., *et al* 16 ed: Harrison's principles of Internal medicine 2005; **6:** 571-576.
2. Pass, R.F. Cytomegalovirus. In: Knipe, D.M., Howley, P.M., editors. Fields Virology. Philadelphia: Lippincott Williams and Wilkins; 2001; 2675-2706.
3. Hillayer, D.C., Shaz, B.H., Zimring, J.C. and Abshire, T.C. Transfusion Medicine and Haemostasis. Clinical and Laboratory Aspects. 1st Edition. Elservier, 2009, New York.
4. Ahmed, S.A. and Baltazar, G. Sentinel surveillance of HIV and STDs in Kenya. In: NASCOP and MOH report 2005; **3:** 16-35.
5. Brian, M. and Tim, W. The effective and safe use of blood components. In: Practical transfusion medicine, 2nd edition. 2005; **6:** 67-84.
6. Strasbourg, G. Guide to the preparation, use and quality assurance of blood components 13th edition 2007, ISBN-13 978-92-871-6136-9.
7. Wikimedia contributors. Blood transfusion. [Internet]. Wikimedia, the free encyclopaedia; 2007 Jan 10, **21:**56. UTC.
8. John, D.R. Human herpesvirus infections; infectious complications of transfusion. In: Blood banking and transfusion medicine, basic principles and practice. 2003; **40:** 465-479.
9. Todd, W.M. and James, M.G. Cytomegalovirus. *Infect. Dis. Soc. Amer.* 2006; **10:**1-12.
10. Thabet, M. El Masri. Neonatal blood transfusion and exchange transfusion. *Paed. Oncol.* 2007; **42:** 61-83.
11. Gerber, G.R. and Stefan, L.P. Prenatal diagnosis of congenital cytomegalovirus. Infection by detection of immunoglobulin M antibodies to the 70d heat shock protein in fetal serum. *J. Clin. Microbiol.* 1998; **27:**2817.
12. Munro, S.C., Hall, B., Whybin, L.R., *et al*. Diagnosis of and screening for cytomegalovirus infection in pregnant women. *J. Clin. Microbiol.* 2005; **43:** 4713-4718.
13. Narvios, A.B., de Lima, M., Shah, H., *et al*. Transfusion of leukoreduced cellular blood components from cytomegalovirus-unscreened donors in allogeneic hematopoietic transplant recipients: analysis of 72 recipients. *Bone Marrow Transplant*. 2005; 348-362.
14. Irene, G.S. and Robbin, P. New strategies for prevention and therapy of cytomegalovirus infection and disease in solid-organ transplant recipients. *Clinic. Microbiol. Reviews*. 2000; **13:** 183-121.
15. Griffiths, P.D. and Stagnos, S. Infection with cytomegalovirus during pregnancy: Specific IgM antibodies as a marker of recent primary infection in pregnant women. *J. Infec. Dis.* 1997; **175:**944.
16. Middeldorp, J.M. and Jongsma, J.A. Detection of immunoglobulin M and G antibodies against cytomegalovirus early and late antigens by enzyme-linked immunosorbent assay. *J. Clin. Microbiol.* 1984; **20:** 763–771.
17. Kothari, A., Ramachandran, V.G., Gupta, P., *et al*. Seroprevalence of cytomegalovirus among voluntary blood donors in Delhi, India. *J. Health Popul. Nutr.* 2002; **20:** 348-351.
18. Hejazi, S., Molla Abaszadeh, A. and Karamiyar, M. Prevalence of anti-CMV antibodies in blood donors in Urmia. *Blood.* 2007; **3(Suppl. 5):** 427-435.
19. Micaela, R.V., J. Pennington, Stephen, F.G., *et al*. Assessment of removal of human cytomegalovirus from blood components by leucocyte depletion filters using real-time quantitative PCR. *Blood.* 2004; **103:** 1137-1139.
18. Mark, E.B. Technical manual of the American Association of the Blood Banks 15th edition 2005; **28:** 667- 711.