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National Cancer Institute Experience in Healthy Egyptian Blood Donors as Regards Blood Group Frequencies and Seroprevalence of Hepatitis B Virus, Hepatitis C Virus & HIV: 10 Year Evaluation

SOHEIR ABDEL LATIF EISSA, M.D.; LOBNA MOSTAFA ABDEL MEGUID, M.D.; SAMIR MORQUS EBEID, M.B.,B.Ch.; RANDA MOHAMED ABOU ELFETOUH, M.D. and GAMAL MOHAMED ABDEL MONEIM, M.D.

The Department of Clinical Pathology, National Cancer Institute.

ABSTRACT

Background: As blood safety is a major concern in Transfusion Medicine. This study attempted to characterize the safety profile of different blood donor groups in order to maximize the use of limited recruitment resources and focus on selected donor groups. The A and B antigens followed by the D antigen are considered the most important, due to their role in blood transfusion and transplantation.

Methods: This is a retrospective study reviewing records of 99757 donors who randomly donated at National Cancer Institute-Blood Bank as well as external blood drives conducted from 2000 to 2005. Donor groups were divided into 6 categories according to location of the blood drives which ultimately provided 6 different socioeconomic groups. Hepatitis B surface antigen (HBsAg), Hepatitis C virus (HCV) and Human immunodeficiency virus (HIV) antibodies (Ab) were examined using ELISA technique. Findings were compared to those of the preceding 5 years. The incidence of different ABO groups was estimated among 102244 healthy Egyptian blood donors using gel card technique. Correlation of prevalence of infectious diseases among different blood groups was not investigated.

Results: No HIV positivity was detected compared to two cases 5 years before. Over all prevalence of HBsAg was 1.30% Vs. 2.13% and HCV Ab reactivity was 4.04% Vs. 6.88% during 2000 to 2005 compared to the preceding five years; respectively. The frequency of groups A, O, B, and AB Rh-positive was 33.6% (n=34364), 27.5% (n=28127), 22% (n=22532), 9.3% (n=9554); respectively; whereas, groups A, O, B, and AB Rh-negative was 2.7% (n=2738), 2.3% (n=2381), 1.8% (n=1830), 0.7% (n=718); respectively.

Conclusion: Decreasing prevalence of HBV, HCV & HIV among healthy non-paid volunteer donors over the last 5 years is mostly due to multiple hypothetical factors including; larger sample size due to increased donors' recruitment efforts leading to more accurate results, and improvements in specificity and sensitivity of blood-borne pathogen detection. Paid donors, constituting a donor category during the preceding 5 years; were no longer accepted for donation as per Ministry of Health regulations. Lastly, the widespread utilization of Hepatitis B vaccination which is a mandatory vaccination according to Ministry of Health regulations and improved public heath awareness, shared in decreasing prevalence of HBV. The relatively higher socioeconomic classes showed lowest prevalence of viral markers, thus it should be targeted by donors' recruitment plans. ABO blood group order of relative frequencies were found to be A+ve, O+ve, B+ve, AB+ve, A-ve, O-ve, B-ve, followed by AB-ve.

Key Words: *HBV – HCV – HIV – Blood group.*

INTRODUCTION

Transfusion transmitted infections are among the most commonly encountered serious complications in transfusion practice. Serological markers for HBV, HCV & HIV were screened in blood banks routinely. These tests are obligatory for transfusion safety and may give an idea about the seropositivity rate of a specific region.

Hepatitis B virus is a member of the Hepadenavirus family (interrupted, circular double stranded DNA). The main modes of transmission are via blood transfusion, I.V. drug abuse; community acquired e.g. household or nosocomial, during intercourse and perinatally from mother to newborn **[1]**. Hepatitis C virus is a member of the Flavivirus family. It is an enveloped virion containing a genome of single stranded

Correspondence: Dr Lobna Mostafa Abdel Meguid, NCI. Clinical Pathology Department, nahedw7@hotmail. com

positive polarity RNA. It is transmitted via blood transfusion, sexually and intravenous (iv) drug abuse is a major route **[1]**.

The causative agent of AIDS was identified in 1983 as a previously unknown retrovirus, which is termed today the Human Immunodeficiency Virus type 1 (HIV-1). In 1986, a further representative of the human pathogenic immunodeficiency virus was isolated (HIV-2). HIV is transmitted through sexual contact, contaminated blood products, inadequately disinfected medical instruments (e.g. injection needles) and from mother to child at birth or during breastfeeding. With the identification of new virus types (HIV-2) and HIV variants (HIV-0), commercially available ELISA screening tests have been continuously optimized and improved in terms of their sensitivity [2].

The ABO blood groups (discovered in 1901) are genetically determined by antigen present on the surface of RBCs and most other body cells. Phenotypically there are 4 groups namely A, B, AB and O determined by 3 allelic genes located near the tip of the long arm of chromosome 9. The Rhesus (Rh) system is controlled by 2 closely linked genes; one gene codes for Dd and the other gene for Cc and Ee.

Both ABO and Rh blood groups exhibit extensive polymorphism and frequency in different populations. There are evidences regarding differences in distribution of blood groups in different ethnic and geographic areas **[3]**. The ABO blood group system is the only system in which antibodies are consistently and predictably present in the serum of normal individuals whose red cells lack the antigens. Unlike this situation, persons whose red cells lack the D antigen do not regularly have the anti-D in their serum. Formation of antibody almost always results from exposure, through either transfusion or pregnancy, to the immunizing red cells possessing the D antigen **[4]**.

The aim of this study was to detect the incidence of HBs-Ag, HCV-Ab, HIV (I&II)-Ab reactivity among different categories of blood donors to characterize the safer groups of population to be targeted through the recruitment plans. Donor selection has a key role in improving blood quality and safety.

During 10 years, a considerable large number of donors donated both at the hospital and outside it at external blood drives: 102244 donors (excluding repeated donors); estimating the relative frequencies of different ABO groups would give an accurate estimate of the general population in Egypt and keep us able to compare the results with different ABO groups distribution among other populations.

MATERIAL AND METHODS

Blood samples were collected from 99757 blood donors in the period between September 2000 and August 2005. The donors age ranged from 18 to 55 years. Blood donors were divided into six groups according to the place of donation. Those who donated blood at faculties, institutes and schools were 32571. Donors from banks, companies, hotels, exhibitions and Clubs were almost from the same socioeconomic and educational class so they are grouped together in one category of 16082 donors. There were 15447 donors from mosques and churches. Serum samples from 14193 soldiers were collected during donations. Those who donated blood for their relatives or patients at the hospital were coming from different cities allover the country, were 11678 donors. Workers who donated blood at new cities, 6 October or 10 Ramadan, factories were 9786. There was no paid donors group.

All samples were examined using enzyme linked immunosorbant assays; For HBs-Ag, kits were purchased from Omega diagnostics limited, pathozyme HbsAg, UK. For HCV Ab detection; kits used were either from Ortho-Diagnostics, UK or Innogenetics, Innotest, Belgium according to the purchasing order. Biotest ELISA kits, Biotest Anti-HIV tetra ELISA, Germany were used for HIV (I&II)-Ab detection.

We estimated the relative incidence of different ABO groups among 102244 healthy blood donors using Dia-med gel cards: Switzerland for ABO & D phenotypes. Repeated donors were excluded.

Findings were compared to those of preceding 5 years (2).

Statistical method: Chi-Square test was used to compare prevalence of infections among groups. As several multiple pair wise comparison was done, *p* value was considered significant

on pair wise basis <0.001 (down word adjustment of α).

RESULTS

Table (1A,1B) summarize the results of anti-HCV and HBs-Ag positivity among 99757 healthy blood donors. There wasn't any HIV-Ab positive result among all donors' samples.

As seen from the table; the best three blood donor categories (high socioeconomic classes) were:

1- Faculties, institutes and schools donors (HBsAg prevalence of 0.7%, and HCV Ab reactivity of 1.26%).

2- Mosques and churches (HBs Ag prevalence of 0.93%, HCV Ab reactivity of 4.33%).

3- Banks, companies, hotels, exhibitions, and clubs donors (HBsAg prevalence of 1.27%, HCV-Ab reactivity of 4.04%).

The following two categories were next to the previously mentioned and were considered lower socioeconomic classes in a respective order:

4- Soldiers group of donors (HBsAg prevalence of 2.12%, HCV Ab reactivity of 5.23%).

5- Donors from factories (HBsAg prevalence of 2.51%, HCV Ab reactivity of 6.35%).

On comparing findings of the years from 2000 to 2005 to those of the preceding 5 years, it was noticed that no HIV Ab positive cases detected compared to two cases in the 5 years before.

The over all prevalence of HBs Ag positivity and HCV Ab reactivity was 1.30% and 4.04% in the previous 5 years; respectively, compared to 2.13% and 6.88% in the period extending from the year 2000 to 2005; respectively.

HBV prevalence among the different groups in the period from 1995 to 2000: The paid donors showed no statistical significant difference from factories workers, but it showed a significant difference from all other groups. Factories workers showed were significantly different from banks–companies–hotels–exhibitions–clubs, faculties–institutes–schools. Hospital blood bank donors did not differ statistically from groups of soldiers, and mosques-churches, but were significantly different from faculties-institutes-schools. Mosques-churches did not differ statistically from banks–companies–hotels–exhibitions–clubs but showed a significant difference from faculties-institutes-schools. Banks-companies-hotels-exhibitions-clubs were only significantly different from faculties-institutes-schools. Faculties-institutes-schools have the least prevalence of HBV.

In the period from 2000 to 2005: Factories workers showed a significantly higher prevalence than hospital blood bank donors, mosques-churches, faculties-institutes-schools, but not differ from other groups. Hospital blood bank donors, soldiers, banks-companies-hotels-exhibitions-clubs, faculties-institutes-schools, mosques-churches did not differ from each other.

Table (1-A): Results of HBs-Ag positivity among 99757 healthy blood donors (2000-2005)** compared to those of 46747 healthy blood donors (1995-2000)*.

Blood Drive	1995-2000	2000-2005	HbsAg			
			No*	%*	No**	%**
Paid donors	6084	0	190	3.12	0	0
Factories	3235	9786	96	2.97	246	2.51
Hospital blood bank donors	13804	11678	333	2.41	177	1.52
Soldiers	3046	14193	72	2.36	301	2.12
Mosques & churches	3490	15447	77	2.21	143	0.93
Banks, companies, hotels, exhibitions, & clubs	8052	16082	138	1.71	204	1.27
Faculties, institutes & schools	9036	32571	88	0.97	227	0.70
	46747	99757	994	2.13	1298	1.30

* Findings of the preceding 5 years 1995-2000. **Findings of the following 5 years 2000-2005.

Table (1-B): Results of anti-HCV among 99757 healthy blood donors (2000-2005)** compared to those of 46747 healthy blood donors (1995-2000)*.

Blood Drive	1995-2000	2000-2005	HCV-Ab			
			No*	%*	No**	%**
Factories	3235	9786	324	10	621	6.35
Hospital blood bank donors	13804	11678	1280	9.27	943	8.08
Mosques-Churches	3490	15447	316	9.05	669	4.33
Paid donors	6084	0	519	8.53	0	0
Soldiers	3046	14193	205	6.73	743	5.23
Banks, companies, hotels, exhibitions, & clubs	8052	16082	384	4.77	650	4.04
Faculties-Institutes-Schools	9036	32571	190	2.1	409	1.26
	46747	99757	3218	6.88	4035	4.04

* Findings of the preceding 5 years 1995-2000. **Findings of the following 5 years 2000-2005.

Table (2): Results of ABO and Rh phenotype of 102244 healthy donors.

	A		O		B		AB	
	Rh +ve	Rh -ve	Rh +ve	Rh -ve	Rh +ve	Rh -ve	Rh +ve	Rh -ve
Number	34364	2738	28127	2381	22532	1830	9554	718
Percentage	33.6	2.7	27.5	2.3	22	1.8	9.3	0.7

HCV prevalence among the different groups in the period from 1995 to 2000: Factories workers and donors at blood banks were significantly different from soldiers, banks–companies–hotels–exhibitions–clubs, and faculties-institutes–schools. Companies–hotels–exhibitions–clubs, faculties-institutes-schools have lower prevalence when compared to all other groups.

In the period from 2000 to 2005: Donors at blood banks had the highest prevalence than all other groups. Students had the lowest prevalence compared to all other groups.

Table (2) summarizes the results of ABO and Rh phenotype of 102244 healthy donors. The incidence of group A Rh-positive has shown the highest incidence), followed by groups O Rh-positive, B Rh-positive, AB Rh-positive, A Rh-negative, O Rh-negative, B Rh-negative, and AB Rh-negative. Group AB Rh-negative has shown the least incidence.

DISCUSSION

In the present study, the incidence of HIV antibody reactivity during the period extending from 2000 to 2005 was found to be 0.0% compared to two cases 5 years before. This is because most of the modes of transmission are not found in this Islamic Oriental country according to its traditions indicating that the blood products supplied for the patients are safe regarding the possibility of HIV transmission. On comparing our results to those of other studies carried out in different countries, the incidence of HIV Ab reactivity in Turkey was 0.001% to 0.00% in two different studies **[5,6]**, in Tanzania it was 1.5% **[7]**, and in Republic of Djibouti 1.9% **[8]**. In Germany, HIV incidence was 0.82% in the year 2003 and 0.48% in 2004 **[9]**. The incidence of HIV among individuals voluntarily donating for the first time was 0.00% in Karachi **[10]**. These findings indicated success of the efforts of world health organizations to fight AIDs.

As regards Hepatitis B virus, the incidence of HBsAg reactivity using ELISA technique in the present study varied according to the category of the blood donors with an overall average incidence of 1.30% compared to 2.13% in the preceding 5 years (1995-2000). The lowest incidence was found among donors at mosques and churches followed by that among students at faculties, institutes and schools, next came the incidence of another high socioeconomic class composed of employees and donors at banks, companies, hotels, exhibitions or clubs. A relatively higher incidence of HBsAg was

detected among donors of relatively lower socioeconomic classes as soldiers and workers at factories. The incidence of HBs-Ag reactivity was greatly reduced after the introduction of the corresponding vaccine and maintained on such level through the ongoing vaccination program as it became obligatory to vaccinate all infants according to Ministry of Health regulations.

The results of the current study are comparable to other studies performed in Asian countries as Turkey **[5,6]** and Kuwait **[11]**, but this incidence is less than that detected in other African countries as Tanzania and the Republic of Djibouti **[10,11]**; and higher than that detected in European countries **[9,13]**.

Assays for detection of HCV antibodies have continued to develop rapidly in the past few years. The incorporation of structural and non-structural HCV genomic antigens has enabled earlier detection and reduced non-specific test results **[9]**. The incidence of HCV Ab reactivity using ELISA technique varied according to the category of the blood donors with an overall average incidence of. 4.04% compared to 6.88% in the preceding 5 years (1995-2000). The lowest incidence was found among students at faculties, institutes and schools followed by that among donors at mosques and churches then donors at banks-companies-hotels-exhibitions or clubs. A relatively higher incidence of HCV-Ab reactivity was detected among donors of lower educational and socioeconomic classes as soldiers and workers at factories.

Incidence among different groups are comparable to other studies in Asian countries as Kuwait (non-Kuwait Arab first time donors) **[11]**, but this incidence is higher than that detected in other African countries as Tanzania and the Republic of Djibouti **[10,11]**; and also higher than that detected in European countries as Germany **[9,12]**, Cyprus **[5]** and Turkey **[6,13]**.

In this study, the commonest blood groups detected were A Rh +ve followed by O Rh +ve. These findings are in agreement with those recorded in Nepal, Tehran, Russian Federation, Kafirs, Kalash, Lappas, North-West of England, Chitrali, Australian aborigines, Western European descent and African descents. In contrast, in West Bank, Syria, Saudi Arabia and Sudan, the commonest blood group was O Rh +ve followed by A Rh +ve **[14,15]**. Also, according to Reid ME and Lomas-Francis C in USA, the commonest blood group phenotype is O Rh +ve followed by A Rh +ve; in Caucasians group O 44%, A 43%, in Blacks group O 49%, A 27%, and in Asians group O 43%, A 27% **[16]**.

According to the findings of this study, it could be concluded that there is a decreasing prevalence of HBV, HCV and HIV among healthy non-paid volunteer donors over 10 years. This could be explained by multiple hypothetical factors:

1) Larger sample size due to increased donors' recruitment efforts leading to more accurate results. 2) Improvements in specificity & sensitivity of blood-borne pathogen detection. 3) Paid donors who constituted one donor category during the preceding 5 years, are no longer accepted for donation as per Ministry of Health regulations. 4) The widespread utilization of Hepatitis B vaccination, which is now mandatory according to Ministry of Health regulations, and improved public heath awareness. The relatively higher socioeconomic classes showed lowest prevalence of HBs-Ag, HCV-Ab; thus it should be targeted (educated, motivated and recruited) through donors' recruitment plans. Vigilance for errors and the effects of donor selection may be as or more important than further reductions to window periods of tests for improving blood safety with respect to HBV, HCV and HIV.

It is necessary to determine blood groups frequencies of different ethnic and geographical areas to meet transfusion, transplantation and forensic medicine needs.

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