Seroprevalence of Transmissible Diseases in Healthy Blood Donors: a Five-year Experience in University Clinical Center Tuzla

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ORIGINAL PAPER

ABSTRACT

Background: The safety of blood products is the most important task of transfusion medicine. Transfusion-transmitted diseases represent a serious public health problem throughout the world, although their percentage of transmission is minimal. Each blood donation is individually tested with serological and molecular tests for the presence of hepatitis B and C viruses, human immunodeficiency virus (HIV), and Treponema Pallidum, regardless of the number of blood donations. Objective: To determine the seroprevalence of blood-borne diseases in healthy blood donors at the University Clinical Center Tuzla, to analyze the possible causes of transmission of these diseases, and to compare with the results of research in countries in the region and beyond. Methods: The research was conducted retrospectively in the period January 1, 2018, until 31.12.2022. years. Samples of blood donors were tested for hepatitis B surface antigen (HBsAg), antibodies to human immunodeficiency virus (HIV1/2), antibodies to hepatitis C and syphilis, using the fourth generation ELISA method. Results: The highest frequency of transmissible disease markers was reactivity to HBsAg with a total of 63.7% of cases and a prevalence of 0.13%, and the lowest for HIV with a total of 1.4% and a prevalence of 0.003%. Conclusion: Bosnia and Herzegovina has a very low seroprevalence but there is still a risk of disease transmission in the population.

Keywords: seroprevalence, transmissible diseases, blood donors.

1. BACKGROUND

Transfusion-transmitted diseases represent a serious public health problem throughout the world, although their percentage of transmission is minimal. Most of the research is related to hepatitis B and C, which are responsible for 96% of all hepatitis mortality (1). Screening for transmissible diseases is an essential and unavoidable step when obtaining a safe blood product in transfusion treatment.

Each blood donation is individually tested with serological and molecular tests for the presence of hepatitis B and C viruses, human immunodeficiency virus (HIV), and Treponema Pallidum, regardless of the number of blood donations (10).

Hepatitis B virus (HBV) infection has shown a medium or high level of endemicity in low-income countries during the last five decades. Almost 240 million people worldwide are infected with the hepatitis B virus (HBV), associated in almost half of the cases with chronic liver disease (6). Despite the development of technology in the detection of transmissible diseases, cases are often detected with one or more markers, most often hepatitis B and C. In the last 20 years, all research in Bosnia and Herzegovina has shown that our country belongs to the group of countries with a low seroprevalence of transmissible diseases. Testing of blood donors should be part of an implemented quality system that includes the processes of collection, testing and marketing of completely safe blood and blood products (1, 2). In May 2016, the WHO adopted the first global strategy to combat viral hepatitis, which aims to eliminate hepatitis as a public health problem, reduce new cases of infection by 90% and reduce deaths by 65% by 2030. Among these goals, the most important place...
4. RESULTS

3. MATERIAL AND METHODS

The research was conducted retrospectively from January 1, 2018 until 31.12.2022 years. The data of testing for blood donors at the Polyclinic for Transfusion were analyzed. Data on test result were collected from the Renovatio RGB Polyclinic for Transfusionology information system.

Serum/plasma samples of blood donors were tested for hepatitis B surface antigen (HBsAg), antibodies to human immunodeficiency virus (HIV1/2), antibodies to hepatitis C and syphilis, using the fourth generation ELISA method. Determination of the results was performed on the ABOTT Architect i2000 automatic analyzer using chemiluminescent microparticle immunoassay technology (CMIA). The test results are expressed quantitatively, where the reactivity of the samples is measured according to the value ≥ 1.00 S/CO as a reactive sample, and all values < 1.00 S/CO are marked as a non-reactive sample.

Statistical analysis

Statistical processing of the data was carried out using the SPSS Statistics 23 program.

4. RESULTS

Retrospective analysis during the selected period 01.01.2018–31.12.2022 were tested 68,933 blood donors aged 18-65. 53,581 (77.7%) donors were suitable for donating and 15,321 (22.3%) of them were not suitable for donating blood. 54,916 (79.6%) were male and 14,017 (20.4%) were female. The majority of donated blood were in UKC Tuzla 48,413 (70.2%) while 20,520 (29.8%) were collected during field work in different locations of Tuzla Canton. 17,562 (25.5%) donors donated for the first time. Number of reactive blood donors was 87.5% in men and 12.5% in women. HBsAg was the most common reactive test (men 63.7%, women 13.6%).

From reactive blood donors were men aged 35-50 with a total of 109 positive tests (75.2%), and the rest were women (24.8%). HBsAg was the most common reactive test during all five observed years, 87.5% in men and 12.5% in women. The second most frequent was the HCV test (anti HCV): 78.95% in men and 21.05% in women. The test for syphilis was sporadically reactive where the proportion of men and women in the sample was almost equal (men 59%, women 41%). The HIV virus was detected in 2 men.

From results, it can be seen that in each

is the implementation of the system for increasing the safety of blood and blood components (6).

2. OBJECTIVE

To determine the seroprevalence of transmissible diseases in healthy blood donors at the University Clinical Center Tuzla, to analyze the possible causes of transmission of these diseases, and to compare with the results of research in other countries.

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From results, it can be seen that in each

Table 1. Number of tested and reactive blood donors for transmissible diseases in the period 2018-2022. (HBsAg–test for hepatitis B surface antigen; HCV–test for the presence of IgG antibodies to hepatitis C; HIV–test for antigen / antibody to the human immunodeficiency virus; Syphilis–test for the presence of antibodies to Treponema Pallidum; ve-gray–limit values of the results between non-reactive and reactive)

<table>
<thead>
<tr>
<th>Year</th>
<th>Tested</th>
<th>HBsAg+ve</th>
<th>HCV+ve</th>
<th>HIV+ve</th>
<th>Syphilis+ve</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>11144</td>
<td>22</td>
<td>12</td>
<td>1 (gray)</td>
<td>2</td>
<td>37 (0,32%)</td>
</tr>
<tr>
<td>2019</td>
<td>11447</td>
<td>13</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>18 (0,16%)</td>
</tr>
<tr>
<td>2020</td>
<td>8843</td>
<td>18</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>29 (0,33%)</td>
</tr>
<tr>
<td>2021</td>
<td>10704</td>
<td>13</td>
<td>4</td>
<td>1 (gray)</td>
<td>1</td>
<td>19 (0,18%)</td>
</tr>
<tr>
<td>2022</td>
<td>11447</td>
<td>22</td>
<td>9</td>
<td>0</td>
<td>4</td>
<td>35 (0,30%)</td>
</tr>
</tbody>
</table>

Table 2. Total number of reactive blood donors to individual markers of blood transmitted diseases

<table>
<thead>
<tr>
<th>Blood transmitted diseases markers</th>
<th>Number (%)</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBsAg</td>
<td>88 (63,7%)</td>
<td>0,13%</td>
</tr>
<tr>
<td>HCV</td>
<td>38 (27,6%)</td>
<td>0,06%</td>
</tr>
<tr>
<td>HIV</td>
<td>2 (1,4%)</td>
<td>0,003%</td>
</tr>
<tr>
<td>Syphilis</td>
<td>10 (7,2%)</td>
<td>0,01%</td>
</tr>
</tbody>
</table>

Graph 1. Prevalence of HBsAg, anti-HCV, HIV and syphilis in the period 2018-2022.

observed year the proportion of reactive tests of the male group is convincingly higher compared to the female group, which can be explained by increased migration of the population, social freedoms and various types of risky sexual behavior.

Also, the higher proportion of men can be explained by the traditionally weaker involvement of women in voluntary blood donation. During the period 2020-2021, the overall response of blood donors was weaker due to the COVID-19 pandemic, and therefore the frequency of reactive samples was lower. During 2022, the number of blood donors returned to the previous level, so the frequency of reactive samples for HBsAg, HCV and syphilis increased.

An overview of the number of detected reactive tests for

Table 3. Results of the survey of blood donors with reactive findings

<table>
<thead>
<tr>
<th>HBsAg</th>
<th>anti HCV</th>
<th>HIV</th>
<th>Syphilis</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 (30,7%)</td>
<td>5 (13,1%)</td>
<td>-</td>
<td>3 (30,0%)</td>
</tr>
<tr>
<td>26 (29,5%)</td>
<td>3 (8,0%)</td>
<td>1 (50%)</td>
<td>4 (40,0%)</td>
</tr>
<tr>
<td>12 (13,6%)</td>
<td>15 (39,5%)</td>
<td>-</td>
<td>2 (20,0%)</td>
</tr>
<tr>
<td>3 (3,41%)</td>
<td>0 (0%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10 (11,36%)</td>
<td>12 (31,6%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10 (11,36%)</td>
<td>3 (8,0%)</td>
<td>1 (50%)</td>
<td>1 (10,0%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>88</td>
<td>38</td>
<td>2</td>
</tr>
</tbody>
</table>
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blood-borne diseases among donors in the examined period is shown in Table 1. It is evident that the highest frequency of transmissible disease markers was reactivity to HBsAg with a total of 63.7% of cases and a prevalence of 0.13%, and the lowest for HIV with a total of 1.4% and a prevalence of 0.003%. A complete overview of the frequency of reactive blood samples of voluntary blood donors and the amount of prevalence in the examined sample is shown in Table 2.

As we can see during period 2018-2022, year, the highest prevalence was 0.13% for HBsAg, and the lowest for HIV was 0.003%. Hepatitis C and syphilis show a low prevalence of 0.06% and 0.01%. The highest prevalence of HBsAg was 0.20% in 2020, and the lowest was 0.11% in 2019. The highest prevalence of anti-HCV was recorded in 2018, and the lowest in 2019, 0.026%.

The highest prevalence of syphilis was in 2022 at 0.035%. The prevalence of HIV was extremely low during all tested periods. A graphic representation is presented in Chart 1.

All reactive blood donors were invited for confidential interview to find out the most likely way of transmitting diseases. All initially reactive samples must be defined by a confirmatory test with another reagent, in order to exclude the suspicion of the existence of a "false positive result". The most common anamnestic information given by subjects with positive HBsAg was hepatitis in close family members (30.7%) and risky sexual behavior (29.5%). When determining the most likely way of transmission of hepatitis C, the largest number of respondents gave the information that in the previous time period they were exposed to mild surgical procedures and other reasons (39.5%).

Of the 2 HIV-reactive samples detected, only one donor reported to the Transmissible Diseases Counseling Center and provided information about risky sexual behavior. 20% of respondents with a reactive test for syphilis gave information about risky behavior, and the rest declared about a past illness in the family and surgical procedures in institutions with debatable hygienic and sanitary conditions. Anamnestic data of possible transmission of hepatitis B and C, HIV and syphilis based on our study are presented in Table 3.

The most likely route of transmission of microorganisms can be determined based on the analysis of the entire survey. In addition to the classical methods of transmission (vertical intrafamilial transmission, sexual contact), the increase number of infected blood donors who deny any of the mentioned methods of transmission and exposure to minor surgical procedures can also be understood as a possible way of transmitting the virus.

5. DISCUSSION

All blood donors are tested for hepatitis B, C, HIV and syphilis. Despite the modernization of the technology, there is still the possibility of virus transmission through transfusions (1,2). The blood-borne diseases that dominate are hepatitis B and C, with a smaller percentage of syphilis and AIDS (7,8). The prevalence in European countries is 0.5–2%, in Africa and Asia varies from > 8% to < 2% in Western Europe, North America and Australia (5,7).

In Southeastern Europe, the prevalence of HBsAg for Albania is 6.7%, Turkey 1.76%. The prevalence of HCV in Turkey is 8.1%. In Western Europe, the prevalence of HBsAg is much lower, eg England 0.31%, Greece 0.4%, and Croatia 0.34%.

In Bosnia and Herzegovina, Salkić et al. in 2007, investigated the prevalence of HBsAg in first time blood donors, which was 3.5%, which confirmed that Bosnia and Herzegovina belongs to the group of countries with medium endemicity for hepatitis B and is in accordance with the examined prevalence in the surrounding countries (3,14). Petrovic et al. in 2009 published the results of research on a sample of 8196 blood donors. HBsAg was positive in 0.787% and anti HCV in 0.267% of blood donors. Compared to other regions of Southeastern Europe, our country has a low endemicity in terms of the spread of hepatitis B and C (4,8).

Our research showed that the largest number of blood donors with a positive marker for hepatitis are donors with positive HBsAg (63.7%) and with positive antibodies to HCV (27.6%). A significant number of respondents with anti HCV gave information that they had undergone various minor operations in the past period procedures in institutions with unverified hygienic and sanitary conditions. The prevalence of HBsAg carriers in Croatia among first time blood donors in the last few years was very low about 0.1%, while at the end of the nineties it was about 0.4% (15,16,17).

In the period between 1999 and 2001, several countries of the European Community (France, Germany, Italy, Spain, Great Britain and Switzerland) introduced mandatory HCV-RNA testing in transfusion institutions (9,10). Since each dose of blood collected must be tested by molecular methods, the final risk of HCV transmission has decreased in France from 1:100,000 to 1:6,650,000, and in Great Britain from 1:520,000 to 1:3,000,000 (11,12,13). Petrovic et al. in their study conducted in 2009, proved the prevalence of hepatitis C among voluntary blood donors of 0.267%, which is in accordance with the results of studies conducted in neighboring countries. For example, in Croatia, the prevalence of HCV in the population of blood donors has been proven to be 0.26% (21).

Testing voluntary blood donors for the HIV virus is also part of the standard tests in all transfusion institutions. The prevalence of HIV-positive blood donors in Europe is 8.9% per 100,000 donations, namely 1.8% in Western Europe and 37.6% in Eastern Europe (19). This group also includes Italy 3.8%, Spain 6.0% and Central European countries 3.8% (20). In 2013, in the Croatian Institute for Transfusion Medicine, among voluntary blood donors in the total number of tested blood doses of 183,072, 3 HIV-positive doses were registered, which is 0.002%, and such a low prevalence has been maintained for years (18).

Our research in a sample of blood donors during the examined period of 5 years, also showed a low prevalence of 0.003%. The reason for such a low prevalence of HIV-infected blood donors in our country and the region of Southeast Europe probably lies in the fact that it is still a society where traditional family values are cherished and where social freedoms are still limited by the influence of tradition. At the end of the last century, a resurgence in the number of people suffering from syphilis is evident, which is associated with an increase in promiscuity, larger population migrations, and a greater number of drug addicts (8).

Despite the increased risk of transmission of infection, the risk of transmission of this bacterium through transfusion is
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very rare today. Since 1960, not a single case of Treponema Pallidum infection through transfusion of blood and blood products has been reported in the United States (22). In Southeastern Europe, North Macedonia has the highest prevalence of syphilis in the population of voluntary blood donors at 0.144%, and the lowest in Croatia at 0.007% (23). Our research showed a relatively low prevalence of syphilis among voluntary blood donors in the examined sample, 0.01%.

Although all previous research has shown a low prevalence of blood-borne pathogens among blood donors, which deviates very little from the prevalences proven in Central and Western European countries, there is still a minimal risk for the transmission of infectious agents through blood.

For this reason, the need arose for the application of highly sophisticated serological blood testing technologies for the causative agents of blood-borne diseases—NAT technology. NAT (nucleic acid testing) actually represents the application of the PCR (polymerase chain-reaction) technique in pools of 24 serum samples from blood donors, where the samples in the plasma pools are first tested in groups, and then, if reactive results appear, the reactive samples are separated and tested individually. Applying this method significantly shortens the duration of the window period for hepatitis B, C and HIV viruses, thus reducing the risk of virus transmission through blood transfusion (23). In addition to the existing enhanced triage during the standard examination of blood donors and the selection of suspicious samples at the Communicable Diseases Counseling Center, it is possible to further minimize the probability of transmission of blood-borne microorganisms.

6. CONCLUSION

The analysis of the obtained data and comparison with earlier research proved that, compared to other regions of Southeastern Europe, Bosnia and Herzegovina has a very low sero-prevalence but there is still a risk of disease transmission in the population. It is very difficult to detect the true way of transmitting the virus, given that a large number of cases refer to vertical intramafial transmission, and that the basic set of markers for hepatitis is not done routinely, but only after the appearance of symptoms.

The goal of reducing the risk of transmission of transmissible diseases in the future should include a better selection of donors during the examination with the use of highly sensitive screening tests that would additionally include NAT technology, which is already present in European countries and in the wider region, which would reduce the risk of infections in the future.

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