

Investigation and Analysis of HIV Infection among Unpaid Blood Donors in Wuzhou City

Lifei Liang*#, Haiyan Wang, Qiong Zeng, Meijie Zhou

Wuzhou Central Blood Station Laboratory, Wuzhou, China

Email: #523237424@qq.com, hywafei@163.com, 332577862@qq.com, 675177721@qq.com

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Abstract

Objective: To take the unpaid blood donors in Wuzhou City as the research object, analyze the characteristics and prevalence of HIV infection, further explore its epidemiological characteristics, and lay a solid foundation for the recruitment of unpaid blood donors and the safety of blood transfusion, so as to reduce the risk of HIV transmission through blood transfusion. **Methods:** This paper collected the anti-HIV test results of unpaid blood donors and the confirmation results of reactive samples from 2015 to 2020, and carried out statistical analysis on the relevant information of positive samples. **Result:** From 2015 to 2020, a total of 233,242 unpaid blood donors were tested, and the positive rate of anti-HIV initial screening was 0.057% (132/233,242), and the positive rate of anti-HIV confirmed was 0.022% (51/233,242); the comparison of positive rates in each year was $P < 0.05$. Among the total number of infections, 76.47% (39/51) of confirmed positive persons were infected with HIV alone, followed by combined TP infection, accounting for 15.69% (8/51); for the people between 46 and 55 years old, the infection rate was the highest, reaching 37.3%; and more men (90.2%) were infected than women. In terms of education background, junior high school and below were the majority, accounting for 58.83% of the total; in terms of marital status, the number of unmarried people was 27, accounting for 52.9%. In terms of occupation, there were two main groups: farmers and workers, accounting for 66.7% of the total number of infections, and students accounting for 15.7%. Among the confirmed positives, the proportion of first-time blood donors and whole blood donors was higher than that of those who donated blood again or donated component blood. **Conclusion:** The situation of HIV infection among unpaid blood donors in Wuzhou City was relatively stable from 2015 to 2020, with no significant change in the absolute number of infected people compared to the previous period (the HIV infection rate from 2010 to

*First author.

#Corresponding author.

2013 was 0.03%), and most of them were males, unmarried people and those with low education. Therefore, attention must be paid to the consultation and recruitment of blood donors before blood donation, as well as the HIV screening in the laboratory after blood donation, so as to ensure the safety of clinical blood use.

Keywords

Unpaid Blood Donors, HIV Infection, Investigation

1. Introduction

Human Immunodeficiency Virus (HIV) is a virus that causes defects in the human immune system. This virus attacks and gradually destroys the human immune system, leaving the host unprotected when infected, often dying from secondary infections or cancer. The main transmission routes of HIV are sexual contact transmission, blood transmission, and mother to child transmission. Domestic AIDS has been in a period of rapid growth, and the number of HIV infections will be increasing. The HIV infection rate in Wuzhou City from 2010 to 2013 was 0.03%. Infusion of blood or blood products containing HIV is the most common form of blood transmission of HIV, In order to ensure the safety of clinical blood transfusion and improve blood quality, the most important preventive measures are to effectively inhibit the transmission of HIV through blood transfusion, and do a good job in HIV testing of blood donors. In order to have a comprehensive understanding of HIV infection among non-remunerative blood donors in this region, strengthen consultation and testing of non-remunerative blood donors, effectively control HIV transmission through blood, encourage and mobilize low-risk blood donors to donate blood regularly, reduce the risk of blood transfusion and ensure blood safety; in this paper, 233,242 non-remunerative blood donors from 2015 to 2020 were selected as research objects to conduct an in-depth analysis of their anti-HIV test results and prevalence. The report is as follows.

2. Materials and Methods

2.1. Survey Subjects

From January 1, 2015 to December 31, 2020, 233,242 blood samples were taken by unpaid blood donors in this city after blood donation, including 160,534 males and 72,708 females, aged 18 - 55 years.

2.2. Instruments and Reagents

2.2.1. Instrument

Xantus44/OH-150 Automatic sampler (Shenzhen Aikang Electronics Co., LTD.), TECAN (Deken) automatic enzyme free workstation FREEDOM EVOLYZER-2 200 (TECAN SCHWEIZ company, Switzerland), FAME24/20, FAME24/30 au-

automatic enzyme free analysis system (Hamilton company, Switzerland), blood nucleic acid detection system (Galif Procleix TIGRIS, Shanghai Kehua), the above instruments and equipment have been verified and calibrated every year.

2.2.2. Reagents

Human immunodeficiency virus diagnostic kit (enzyme-linked immunoassay, Beijing Wantai Bio-Pharmaceutical Co., LTD., Zhuhai Lizhu Reagent Co., LTD.). The kit has been approved by the manufacturer and approved by the China Institute for Pharmaceutical and Biological Products Inspection; nucleic acid detection reagents (Gailifu Pharmaceutical Consulting, Shanghai Kehua Biological Engineering Co., LTD.) have manufacturers inspection report, and reagents are used within the validity period.

2.3. Methods

2.3.1. Serological Testing

Each blood specimen shall be tested twice with ELISA reagents from 2 different manufacturers, and the operation shall be conducted in strict accordance with the instructions of the kit. For any specimen that is reactive to the reagent from 1 manufacturer, double-well retest shall be conducted with the original reagent. If 1 or 2 Wells are reactive, it shall be judged as anti-HIV reactive. The reactive specimens were sent to the AIDS testing and confirmation laboratory of Wuzhou Center for Disease Control and Prevention for confirmation.

2.3.2. Viral Nucleic Acid Detection

The negative ELISA specimens were detected by PCR-fluorescence method or TMA method. The detection mode of PCR-fluorescence method was mixed detection of HBV DNA, HCV RNA and HIV RNA combined with 8 human samples. The detection mode of TMA method was single HBV DNA, HCV RNA and HIV RNA joint detection. 8 mixed reactive specimens were separated and tested as HIV and RNA reactive specimens or single co-reactive specimens were identified as HIV and RNA reactive specimens which were sent to the AIDS detection and Confirmation Laboratory of Wuzhou Center for Disease Control and Prevention.

2.3.3. Statistical Analysis

The data were obtained from the management information system software of Tangshan Qiao Blood Bank and the confirmative experimental report provided by Wuzhou Center for Disease Control and Prevention. The SPSS25.0 software statistical data was used and χ^2 test was adopted, indicating that $P < 0.05$ was statistically significant.

3. Results

3.1. Preliminary Screening and Confirmation Results

Among 233,242 samples tested, there were 132 anti-HIV positive cases in preliminary screening, with a positive rate of 0.057%, and 51 confirmed positive

cases with a positive rate of 0.022%. The confirmed positive rates from 2015 to 2020 were 0.032%, 0.032%, 0.022%, 0.015%, 0.011% and 0.022%, respectively. The comparison of the confirmed positive rate in each year was significant ($P < 0.05$).

3.2. Specific Situation of Coinfection among HIV Positive Blood Donors

For HIV confirmed positive individuals, the most common combination of TP infection was 8, accounting for 15.69%; secondly, there were 3 patients with HCV infection, accounting for 5.88%; one person (1.96%) was associated with ALT positive. See **Table 2**.

3.3. Gender and Age Characteristics

For HIV-positive people, the majority were middle-aged and elderly people aged between 46 and 55, accounting for 37.3%; the second was teenagers and middle-aged people, aged between 18 - 25 and 36 - 45, accounting for 23.5%; Most of them were male.

3.4. The Situation of Educational Background, Marriage and Occupation

For HIV-positive persons, the main educational background was junior high school, accounting for 58.8% of the total number, followed by secondary secondary school, accounting for 25.5%; in terms of marriage, 27 people were unmarried, accounting for 52.9%, and 24 people were married, accounting for 47.1%. In terms of occupation, there were two main types, farmers and workers, which accounted for 35.3% and 31.4% of the total number of infections respectively.

3.5. Number and Form of Blood Donation

For HIV-positive patients, mainly first-time blood donors and whole blood donors. 35 cases (68.6%) were among the first blood donors; there were 16 cases (31.4%) of re blood donors. There were 48 people who donated whole blood, accounting for 94.1%; there were 3 cases (5.9%) who donated blood.

4. Discussion

In Wuzhou City, the total HIV infection rate among unpaid blood donors was 0.022%, which was higher than the confirmed HIV positive rate of 0.018% in China [1]. From 2015 to 2020, the HIV infection rate among unpaid blood donors in Wuzhou City ranged from 0.011% to 0.032% ($P < 0.05$). The infection rate peaked in 2015 and 2016, decreased from 2017, reached the minimum in 2019, and began to increase again in 2020, indicating that the HIV infection rate among voluntary blood donors in Wuzhou has always been at a high level. In addition, combined with relevant data, it can be concluded that since 2017, the number of testing and confirmed positive has been decreasing, and in 2020, the

number of HIV infections began to increase again; In that year, the number of testing was 17, and there were 10 confirmed positive cases, indicating that the current situation of HIV infection among blood donors is very serious.

It can be seen from **Table 1** that the number of positive specimens in preliminary screening is more than that of confirmed positive specimens; this is due to the decrease of specificity after the sensitivity of ELISA test is improved, which leads to the increase of false positive in the initial screening. WB test should be the main method to confirm HIV infection. There are many reasons for false positive ELISA, which is not only closely related to the temperature and humidity of the laboratory, but also may be related to hemolysis or fibrin, and also closely related to other antibodies. HIV Ab (or Ag/Ab) project screening with two enzyme free reagents has higher reactivity of a single reagent, and this type of specimen can be confirmed only after being submitted for examination; combined with the previous data, the confirmation results of this type of specimen are mainly negative, and there are uncertain results, and no positive confirmatory specimens have been found, so the positive rate of confirmation is not high. In addition, for ELISA tests, critical value (Cutoff value) are used as the judgment principle for reactivity and non-reactivity; different laboratories set different ranges of grey zones, which aim to reduce the possibility of missed detection of weak positive specimens; in this way, after sensitivity increases, specificity decreases, resulting in an increase in the proportion of false positive results. The setting standard of the grey area threshold is inconsistent, and there are certain differences between different laboratories; this laboratory sets the grey area range based on the previous literature and data, mainly domestic reagents, and the grey area range is between 0.85 and 1.0 CO value; as a result, the confirmed positive rate is not high in HIV screening; therefore, the laboratory should pay attention to the setting of the threshold value of the gray area, and verify whether it is suitable before setting to reduce the waste of blood resources and the unnecessary psychological burden of blood donors.

Table 1. HIV test results of unpaid blood donors in Wuzhou City from 2015 to 2020.

	Total number of unpaid blood donations (n)	Reactivity number of primary screening (%)	The number of confirmed positive (%)
2015	34,432	31 (0.090)	11 (0.032)
2016	34,595	31 (0.090)	11* (0.032)
2017	36,749	23 (0.063)	8 (0.022)
2018	38,760	16 (0.041)	6 (0.015)
2019	44,058	14 (0.032)	5 (0.011)
2020	44,648	17 (0.038)	10 (0.022)
Total	233,242	132 (0.057)	51 (0.022)

Note: * One sample with negative enzyme immunoassay and positive nucleic acid test (“window period” of enzyme immunoassay) was sent to the AIDS testing laboratory of Wuzhou Center for Disease Control and Prevention to be confirmed as positive; The comparison of confirmed positive rate in each year was $\chi^2 = 22.14$, $P < 0.05$.

For HIV, its transmission route is the same as that of HBV, HCV and TP, and co-infection is very common. As can be seen from **Table 2**, among the 51 infected persons, 39 were infected with HIV alone, accounting for 76.47% of the total, followed by 8 people co-infected with TP, accounting for 15.69%. For TP, it is mainly transmitted through sexual routes, which leads to a higher probability of TP patients infected with HIV. More and more people are co-infected with HIV and TP, making the transmission of HIV through sexual contact more and more obvious.

Among the infected people in this city, there are more males than females, which is consistent with the reports in Nanjing [2] and Zhongshan [3]; The main group is 46 - 55 years old, middle school and below, and the infected people are mainly middle-aged and elderly, which is inconsistent with the reports of Xu Tingting *et al.* [4] from Wuhan Blood Center; the main reason is that there are not many colleges and universities in this city, and blood donors are mainly from the streets and rural areas; this indicates that this group has the possibility of high-risk behaviors of HIV infection. Among them, 90.2% are male, and unmarried is higher than married, which is inconsistent with the reports of Yang Nan *et al.* [5], but consistent with the reports of Xiang Shunzhen *et al.* [6], indicating that it is regional. The confirmed positive blood donors are mainly in two groups, one is farmers, the other is workers; these groups have low education, not strong awareness of self-protection, high-risk behavior, and they are easy to become susceptible people; therefore, blood collection and supply institutions should strengthen the medical consultation of these groups, at the same time do a good job in the promotion of AIDS prevention knowledge. It should be noted that the number of infected college students has been increasing in recent years [7], which is related to the sexual concept of college students; they are very active in thinking and lack knowledge of AIDS prevention; meanwhile, some colleges and universities lag behind sex education; therefore, it is necessary to strengthen the cooperation between colleges and universities and promote the knowledge of AIDS prevention in depth.

Table 3 shows that 94.1% of HIV-positive people in Wuzhou donated whole blood and 5.9% donated component blood; component donors are mainly recruited from repeat donors which compared with whole blood donors, their overall risk is not high, but the interval of component donors is much shorter than that of whole blood donors; therefore, for component blood donors who have high-risk behaviors, it is still in the window period; so it is necessary to strengthen HIV screening, and select reagents and methods with high sensitivity and specificity to reduce the risk of window period.

In general, the situation of HIV infection among unpaid blood donors in Wuzhou is not optimistic. In order to effectively curb the spread of AIDS through blood transfusion, our station achieved full coverage of nucleic acid testing in 2016, further shortening the “window period” of testing. At the same time, we detected a sample with negative ELISA and positive nucleic acid testing in this year (the “window period” of ELISA), which was confirmed as positive by

Table 2. The situation of confirmed HIV positive people with other infections among unpaid blood donors in Wuzhou City from 2015 to 2020.

	Number of people (n)	Percentage (%)
HIV	39	76.47
HIV + HCV	3	5.88
HIV + TP	7	13.73
HIV + ALT	1	1.96
HIV + HBV + TP	1	1.96

Table 3. Distribution condition of HIV-positive persons confirmed by sex, age, education background, occupation, marriage, number of blood donation and blood donation form.

		Number of cases	Confirmed positive Number	Confirmed positive rate (%)	Proportion of confirmed positive rate (%)
Sex	Male	160,534	46	0.028	90.2
	Female	72,708	5	0.007	9.8
Age (year)	18 - 25	49,820	12	0.024	23.5
	26 - 35	55,339	8	0.014	15.7
	36 - 45	60,969	12	0.019	23.5
	46 - 55	67,114	19	0.028	37.3
Educational background	Junior high school and below	66,507	30	0.045	58.8
	Technical secondary school or high school	84,426	13	0.015	25.5
	University or above	82,309	8	0.010	15.7
occupation	farmer	6903	18	0.260	35.3
	worker	4607	16	0.347	31.4
	student	29,299	8	0.027	15.7
	teacher	2497	2	0.080	3.9
	staff	12,823	4	0.031	7.8
	doctor	7059	0	0.000	0
	other	170,054	3	0.002	5.9
Marital status	married	142,083	24	0.017	47.1
	unmarried	91,159	27	0.030	52.9
Number of blood donations	First time	78,819	35	0.044	68.6
	again	154,423	16	0.010	31.4
Form of blood donation	Whole blood	222,892	48	0.021	94.1
	Component Blood	10,350	3	0.028	5.9

the AIDS testing laboratory of Wuzhou Center for Disease Control and Prevention, avoiding the occurrence of HIV infection through blood transfusion; however, the “window period” of detection cannot be completely avoided. So it is necessary to strengthen publicity, and the recruitment of blood donation is also crucial. We must formulate scientific measures, apply reagents and methods with

high sensitivity and specificity to further improve the blood screening strategy for blood donors; at the same time, we must do a good job of effective physical examination and consultation, constantly strengthen the staff's consultation skills, and start from the source to ensure that blood is collected from low-risk blood donors.

5. Conclusion

The situation of HIV infection among unpaid blood donors in Wuzhou City was relatively stable during the period from 2015 to 2020, with no significant change in the absolute number of infections compared to the previous period, with the majority of them being male and unmarried persons with low educational background. Therefore, we must pay attention to the consultation and recruitment of blood donors before blood donation, as well as the HIV screening in the laboratory after blood donation, so as to ensure the safety of clinical blood use.

6. Limitations of the Study

As the object of this study is the sample of a certain period, the data obtained has limitations, which can only understand the prevalence of HIV infection among blood donors in this city within a certain period.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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