

Short Communication

The Comparison of Human Immunodeficiency Virus Type 1 Transmission between Couples through Blood or Sex in Central China

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SUMMARY: To examine whether there are any differences in the rates of HIV-spousal transmission between those who have acquired the virus through blood or through sex in central China. A total of 650 HIV-infected individuals were enrolled, 420 of them were either former commercial plasma donors or recipients of blood (blood transmission group [BTG]), and 230 had acquired HIV infection through sex (sex transmission group [STG]). The spousal transmission rate of HIV was 2% per year (94/420, 11.2 years) in BTG and 8.9% per year (115/230, 5.6 years) in STG. There was a significantly higher transmission rate of HIV through male-to-female (11.7% per year, 84/128, 5.6 years) than through female-to-male (5.4% per year, 31/102, 5.6 years, $P < 0.05$) in STG, but there was no significant gender based differences in BTG. In BTG, all HIV-1 tested were subtype B', while in STG, HIV-1 tested were predominantly subtypes CRF01_AE or CRF07_BC. Our results show that the HIV-spousal transmission rate was higher in STG than in BTG, and that there was a higher rate through male-to-female than female-to-male in STG.

The Chinese government has paid great attention to HIV prevention, banning all illegal plasma donation stations since 1996 and reinforcing the administration of blood donation and transfusion through legal blood and plasma donation stations. Therefore, direct HIV acquisition through blood donation and transfusion has been under control. A recent trend is that HIV is spreading from a population with well recognized risk factors to the general population. Secondary transmission including HIV transmission between couples from infections acquired through either blood/plasma donation or blood transfusion, still occur. In addition, the number of people who have multiple sex partners is on the rise in China, which also results in HIV transmission from individuals with high risk behavior to their spouse via sexual relations. In light of this, the study was performed to evaluate the patterns of spousal transmission of HIV in central China.

Between September 2005 and December 2009, the study enrolled 650 HIV-infected persons with spouses that denied any high risk behavior for contracting HIV infection. Epidemiological data about the route of HIV acquisition and the time of primary HIV infection was obtained, as well as blood samples (5 ml) for later HIV and syphilis antibody testing. HIV genotyping was conducted according to the study by Su et al. (1). Those couples with both the wife and husband infected with HIV were defined as HIV transmission between couples. According to the route of primary HIV infection of the husband or wife, 420 former commercial blood donors or blood recipients were assigned to the blood

transmission group (BTG), and 230 individuals who had unprotected intercourse with multiple sex partners were assigned to the sex transmission group (STG). In central China, HIV-related commercial plasma donation and transfusion through illegal blood and plasma donation stations existed from 1993 to 1996. For STG, HIV-acquisition time was calculated according to the time that high risk sexual intercourse occurred. The medium time of HIV-potential transmission between couples was 11.2 years in BTG and 5.6 years in STG. This is a retrospective study. No study enrollees used condoms during intercourse with their spouses since they were not aware of their spouses' HIV-infection status. So the HIV transmission between couples occurred naturally and without any intervention.

Statistical significance was determined by the Student *t* test using SPSS software (version 13.0). Differences were considered to be significant if a *P* value of < 0.05 was obtained. The sequences were analyzed by SeqMan II, Bioedit and Mega 3 software. The GenBank accession numbers of our sequences are HM241594–HM241615.

Descriptive data for the individuals were presented in Table 1. The percentage of curable sexually transmitted diseases (STDs) was 39.6% in STG (91/230) and 1.2% in BTG (5/420). Table 2 shows the transmission rate of HIV was 2.0% per year in BTG, and 8.9% per year in STG ($P < 0.05$). In STG, the rate of male-to-female transmission was 11.7% per year, much higher than the rate of female-to-male transmission ($P < 0.05$). However, there was no significant difference between male-to-female and female-to-male HIV transmission in BTG. The gag regions of 90 HIV isolates in BTG and 81 in STG were sequenced to determine the HIV-1 subtype. All 90 HIV isolates in BTG were HIV-1 subtype B'. In STG, 52 HIV isolates were of subtype CRF01_AE, 21 of subtype CRF07_BC, 5 of B subtype and 3 of B' subtype

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(Fig. 1).

There is an increased risk of HIV transmitted from high risk groups to their spouses, especially people having unprotected intercourse with multiple sex partners (2). Our finding shows that the heterosexual transmission of HIV occurs at a high rate among stable sex partners. More extensive screening of HIV and wide promotion of condom use among high risk people need to be given greater importance.

Our study also shows that the rate of spousal transmission of HIV in STG was higher than that in BTG (8.9% per year versus 2.0% per year, $P < 0.01$). These differences might be attributed in part to the higher prevalence of curable STDs in STG. The risk of HIV infection is 4–5 times higher in individuals coinfecting with syphilis and 5–10 times higher in individuals with ulcerative STDs (3). HIV viral load in genital secretions is higher in the presence of coinfection with STDs (4). Infection with STDs results in the accumulation of HIV target cells (including CD4 T lymphocytes and macrophages) within the genital mucosa (5). All these factors increase the rate of HIV transmission.

Other studies have shown that receptive vaginal intercourse is associated with a higher risk of HIV transmission than inserted vaginal intercourse. Moreover, the viral load in semen is higher than that in vaginal secretions, which explains the findings that HIV is more

easily transmitted from male-to-female than from female-to-male (6). The greater genital mucosa area during intercourse is another possible factor for females to acquire HIV. It was reported that the risk of male-to-female transmission per intercourse ranged from 1/200 to 1/2,000, and that the risk of female-to-male transmission per intercourse ranged from 1/700 to 1/3,000 as long as there were no concurrent STDs (7). The results of our study show that the risk of male-to-female transmission is 2.2 times higher than the risk of female-to-male transmission in STG, which is consistent with the study of Nicolosi et al. (8).

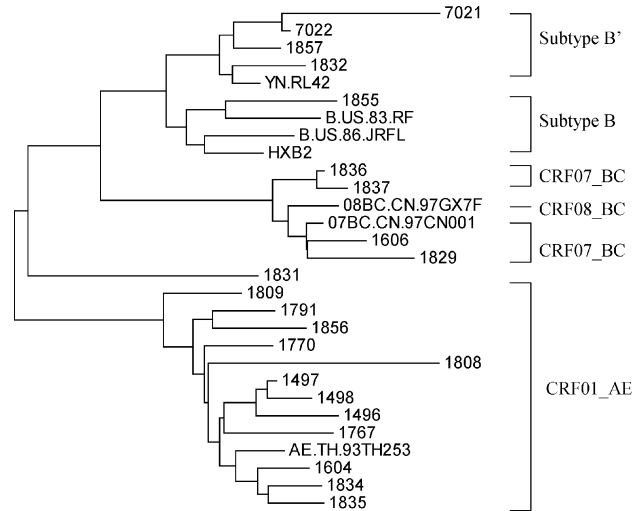


Fig. 1. Different HIV subtypes distribution among patients in blood transmission group (BTG) and sex transmission group (STG): HIV-1 subtype B' in BTG and HIV-1 CRF01_AE or CRF07_BC in STG. The sequences reported in the present study have been deposited in GenBank under accession number as follows: 7021, HM241614; 7022, HM241615; 1857, HM241613; 1832, HM241606; 1855, HM241611; 1836, HM241609; 1837, HM241610; 1606, HM241598; 1829, HM241604; 1831, HM241605; 1809, HM241603; 1791, HM241601; 1856, HM241612; 1770, HM241600; 1808, HM241602; 1497, HM241595; 1498, HM241596; 1496, HM241594; 1767, HM241599; 1604, HM241597; 1834, HM241607; and 1835, HM241608.

Table 1. Characteristics of 650 HIV-positive subjects

Characteristics	BTG	STG
Total no.	420	230
Medium age (y, range)	38 (27–65)	36 (20–67)
Gender (M:F)	1:2.2	1.3:1
STD (no., %)	5 (1.2)	91 (39.6)
Condyloma acuminatum	3 (0.7)	59 (25.7)
Syphilis	1 (0.2)	21 (9.1)
Gonorrhoea	1 (0.2)	11 (4.8)
Average CD4 lymphocyte count (cells/ μ l)	163	245

BTG, blood transmission group; STG, sex transmission group; STD, sexual transmitted disease.

Table 2. Rates of HIV transmission between couples in BTG and STG

Group	Total	Medium time of potential HIV transmission (y)	HIV-transmitted couple					
			No.		Male-to-female		Female-to-male	
			No.	% per year	No.	% per year	No.	% per year
BTG	420	11.2 (11.2 \pm 2.3)	94	2.0 ¹⁾	27	1.8 ²⁾	67	2.1 ²⁾
STG	230	5.6 (5.6 \pm 3.1)	115	8.9 ¹⁾	84	11.7 ³⁾	31	5.4 ³⁾

¹⁾ In blood transmission group (BTG), 94/420 persons were infected by their spouses. The medium time of potential HIV transmission was 11.2 years. So the rate of HIV transmission between couples was 2.0% per year. In sex transmission group (STG), 115/230 persons were infected by their spouses. The medium time of potential HIV transmission was 5.6 years. So the rate of HIV transmission between couples was 8.9% per year. The rate of HIV transmission between couples was significantly higher in STG than in BTG ($P < 0.05$).

²⁾ In BTG, 27/132 wives and 67/288 husbands were infected by their spouses. The medium time of potential HIV transmission was 11.2 years. So the HIV male-to-female and female-to-male transmission rates were 1.8% per year and 2.1% per year, respectively. There were no significant differences between the rates of HIV male-to-female transmission and female-to-male transmission.

³⁾ In STG, 84/128 wives and 31/102 husbands were infected by their spouses. The medium time of potential HIV transmission was 5.6 years. So the HIV male-to-female and female-to-male transmission rates were 11.7% per year and 5.4% per year, respectively. The rate of HIV male-to-female transmission was significantly higher than the rate of female-to-male transmission ($P < 0.05$).

In contrast, in BTG, in which the incidence of STDs were low (1.2%), the rates of male-to-female and female-to-male transmission were similar. However a difference can be found in the rates between HIV male-to-female transmission and female-to-male with the presence of STDs. This suggests that STDs may play an important role in HIV male-to-female transmission. However, it is also possible that recombinant HIV-1 subtypes may be another factor affecting the efficiency of HIV transmission from male-to-female and from female-to-male.

The number of times intercourse takes place between couples is an important factor that can influence HIV transmission. However, this was a retrospective study and the difference in the level of sexual activity of couples in BTG and STG was not well reported. The ages of enrollees in BTG and STG were similar, and there may be no significant difference in sexual activity levels among these persons. This data should be included in future studies.

In summary, this study found that routes of HIV acquisition and gender of initially-positive-individuals were two factors which might influence HIV transmission between couples. STDs may play an important role

in HIV male-to-female transmission.

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