Detection of human immunodeficiency virus (HIV) RNA in the sweat of HIV-infected patients

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OBJECTIVE: Human immunodeficiency virus (HIV) infection is a significant health problem. Many studies reported that HIV was mainly transmitted through parenteral exposure, sexual activity, and body secretions, such as saliva and semen. Many people, including health-care providers and patient relatives, may easily contact with the sweat of HIV-infected patients. Although reference books state that HIV does not transmit through sweat, to our knowledge, there is no systemic study which this statement is based upon. This study aims to investigate the potential of sweat to transmit HIV infection.

METHODS: This study included 31 treatment-naive HIV RNA-positive patients who were in the acute phase of the infection and 26 subjects with a negative HIV RNA test who had received antiviral treatment. A total of 57 sweat samples collected from intact skin areas were prospectively evaluated by polymerase chain reaction (PCR) for the presence of HIV RNA. HIV RNA levels in the blood samples were also noted.

RESULTS: HIV RNA was not detected by PCR in any sweat sample taken from HIV-infected HIV RNA-negative and -positive subjects.

CONCLUSION: The findings obtained in this study suggest that sweat by itself has no potential for transmitting HIV infection.

Keywords: HIV; HIV transmission route; polymerase chain reaction; sweat.

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Human immunodeficiency virus (HIV) infection is a worldwide health problem [1]. Although the worldwide incidence of HIV infection has decreased, the prevalence of HIV infection has increased with the increased life expectancy among patients receiving antiviral treatment (ART) [2].

Many studies reported that HIV was mainly transmitted through parenteral exposure, sexual activity, and body secretions, such as saliva and semen [1–3] A high HIV RNA level in blood is the greatest risk factor for the transmission of HIV [4] Risk of transmission can be reduced through early diagnosis, protection and decreasing HIV RNA levels by early treatment [5].

HIV-positive individuals get in contact with others in their daily lives. Health providers are in daily contact with patients, their blood and fluids. Some of the patients may be infected, or their fluids may be contaminated with HIV. Otorhinolaryngologists often get in contact with the face and scalp of patients during the physical examination, which gives rise to doubts about HIV transmission through exposure to sweat. Although reference books state that HIV is not transmitted via
sweat, to our knowledge, there is no systematic study on which this statement is based. In this study, we aimed to investigate the potential of contact with the sweat of HIV-positive patients to cause HIV infection.

**MATERIALS AND METHODS**

This study was approved by the local ethics committee. The patients were divided into two groups. Group 1 consisted of 31 treatment-naive HIV RNA-positive patients who were in the acute phase of the infection and Group 2 included 26 subjects with a negative HIV RNA test who had received antiviral treatment. The participants were asked to walk until they sweat. Sweat samples were collected from the face by an otorhinolaryngologist and put in sterile Eppendorf tubes. 0.5 cc sterile saline was added to the tubes and the samples were placed in a deep freeze (-32°C). After the collection of all the samples, the presence of HIV RNA was evaluated using the PCR method.

HIV RNA extraction followed by amplification and detection was performed according to the methodology mentioned elsewhere [6]. Briefly, RNA was extracted using

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**Table 1. Sweat HIV RNA concentrations and serological parameters in group 1**

| Patient no. | Gender | Age | ART | CD4 | Serum HIV RNA (IU) | Sweat HIV RNA |
|-------------|--------|-----|-----|-----|-------------------|--------------|
| 1           | M      | 26  | Naive | 362 | 476973           | None detected |
| 2           | M      | 26  | Naive | 803 | 329              | None detected |
| 3           | M      | 59  | Naive | 8   | 775,774          | None detected |
| 4           | M      | 26  | Naive | 1046| 114              | None detected |
| 5           | M      | 45  | Naive | 481 | 3290             | None detected |
| 6           | M      | 26  | Naive | 675 | 19200            | None detected |
| 7           | F      | 23  | Naive | 398 | 183303           | None detected |
| 8           | M      | 40  | Naive | 255 | 626246           | None detected |
| 9           | M      | 27  | Naive | 262 | 16410            | None detected |
| 10          | M      | 29  | Naive | 244 | 2187265         | None detected |
| 11          | M      | 21  | Naive | 287 | 482929          | None detected |
| 12          | M      | 24  | Naive | 807 | 1068449         | None detected |
| 13          | M      | 37  | Naive | 906 | 102156           | None detected |
| 14          | M      | 32  | Naive | 410 | 87748           | None detected |
| 15          | M      | 31  | Naive | 254 | 14854           | None detected |
| 16          | M      | 30  | Naive | 301 | 322190          | None detected |
| 17          | M      | 33  | Naive | 382 | 928394         | None detected |
| 18          | M      | 22  | Naive | 170 | 610494          | None detected |
| 19          | M      | 42  | Naive | 209 | 583             | None detected |
| 20          | M      | 44  | Naive | 372 | 248,726       | None detected |
| 21          | M      | 36  | Naive | 312 | 5169            | None detected |
| 22          | M      | 34  | Naive | 230 | 435523         | None detected |
| 23          | M      | 26  | Naive | 397 | 5778788        | None detected |
| 24          | M      | 38  | Naive | 279 | 395533         | None detected |
| 25          | M      | 21  | Naive | 616 | 436            | None detected |
| 26          | M      | 28  | Naive | 237 | 49902          | None detected |
| 27          | M      | 24  | Naive | 413 | 52912           | None detected |
| 28          | M      | 30  | Naive | 320 | 437461         | None detected |
| 29          | M      | 47  | Naive | 410 | 214             | None detected |
| 30          | M      | 29  | Naive | 646 | 303,856        | None detected |
| 31          | M      | 45  | Naive | 226 | 348,851        | None detected |

HIV: Human immunodeficiency virus; M: Male; F: Female; ART: Antiretroviral therapy.
the ready-to-use RNA extraction kit (QIAampUltraSens, QIAGEN, Hilden, Germany) according to the manufacturer’s instructions. A 240 bp region of HIV RNA was reverse transcribed and amplified. Amplification and detection were performed in Rotor-Gene 2000/3000 (Corbett Research, Hamburg-Germany). Amplification protocol was as follows: one cycle of 50°C for 10 min, 45 cycles of 95°C for 8 s, 55°C for 20 s, and 72°C for 20 s.

**RESULTS**

A total of 57 patients were included in this study. The study group consisted of three (5.2%) female and 54 (94.7%) male patients. The mean age of the patients was 34.8±10.9 years (range: 21–71). PCR assay showed no detectable HIV RNA in sweat samples of the two groups (Table 1, 2). HIV RNA levels in serum and sweat samples are shown in Table 1 and 2.

**DISCUSSION**

Studies showed that various body fluids, such as genital secretions, semen feces and saliva, may be HIV RNA positive in HIV-positive patients [4, 7–17]. In their study, Kantor et al. reported that HIV RNA was detected in genital secretions in 82 out of 143 HIV-positive patients [7]. Cotten et al. found HIV RNA in 12 out of 20 feces samples [9]. In their cross-sectional study, Liuzzi et al. detected HIV1 RNA in 25 semen samples out of 26 [10]. Balamane et al. reported measurable saliva HIV-1 RNA in 36 of 47 (77%) patients with plasma viremia [12]. Lourenco et al. [13] detected HIV RNA in 34 saliva

| Patient no. | Gender | Age | ART | CD4 | Serum HIV RNA (IU) | Sweat HIV RNA |
|-------------|--------|-----|-----|-----|-------------------|--------------|
| 1           |  M     | 44  | +   | 617 | Negative          | None detected |
| 2           |  M     | 34  | +   | 313 | Negative          | None detected |
| 3           |  M     | 42  | +   | 346 | Negative          | None detected |
| 4           |  M     | 49  | +   | 173 | Negative          | None detected |
| 5           |  M     | 27  | +   | 736 | Negative          | None detected |
| 6           |  M     | 34  | +   | 966 | Negative          | None detected |
| 7           |  M     | 39  | +   | 560 | Negative          | None detected |
| 8           |  F     | 40  | +   | 988 | Negative          | None detected |
| 9           |  M     | 29  | +   | 999 | Negative          | None detected |
| 10          |  F     | 33  | +   | 424 | Negative          | None detected |
| 11          |  M     | 54  | +   | 482 | Negative          | None detected |
| 12          |  M     | 35  | +   | 691 | Negative          | None detected |
| 13          |  M     | 28  | +   | 519 | Negative          | None detected |
| 14          |  M     | 31  | +   | 822 | Negative          | None detected |
| 15          |  M     | 60  | +   | 594 | Negative          | None detected |
| 16          |  M     | 51  | +   | 527 | Negative          | None detected |
| 17          |  M     | 26  | +   | 571 | Negative          | None detected |
| 18          |  M     | 33  | +   | 680 | Negative          | None detected |
| 19          |  M     | 22  | +   | 512 | Negative          | None detected |
| 20          |  M     | 32  | +   | 542 | Negative          | None detected |
| 21          |  M     | 24  | +   | 791 | Negative          | None detected |
| 22          |  M     | 25  | +   | 708 | Negative          | None detected |
| 23          |  M     | 56  | +   | 406 | Negative          | None detected |
| 24          |  M     | 28  | +   | 1113| Negative          | None detected |
| 25          |  M     | 37  | +   | 350 | Negative          | None detected |
| 26          |  M     | 71  | +   | 1223| Negative          | None detected |

HIV: Human immunodeficiency virus; M: Male; F: Female; ART: Antiretroviral therapy.

**Table 2.** Sweat HIV RNA concentrations, transmission routes, and serological parameters in group 2
samples out of 57 and suggested that saliva may facilitate HIV entry and possibly other pathogens via the genital mucosa during heterosexual intercourse (Table 3). Detection of HIV RNA in samples collected, even from patients receiving the treatment demonstrates that the most efficient way to halt the disease progression is to know the ways of transmission and protection against transmission.

In addition to these studies showing the ways of transmission, there have been various studies reporting no HIV RNA in some body fluids. In a previous study, HIV RNA was not detected by PCR in ear cerumen of patients with a positive test for serum HIV RNA [6]. Likewise, in a study, including 23 patients infected with HIV, Mohlala et al. [11] reported that no HIV RNA was found in amniotic fluids and umbilical cord blood of 23 HIV-infected pregnant women who received single-dose nevirapine or short-term zidovudine treatment before elective cesarean section (Table 3).

Although some statements are suggesting that HIV is not transmitted through sweat, in the literature, there are only a limited number of studies that we conducted on patients with a positive test for serum HIV RNA supporting those statements. Wormser et al. could not demonstrate HIV-RNA in eccrine sweat samples of 50 HIV-infected patients [18]. Reliable information and comment on this matter require more scientific research on patient samples. Thus, in this study, to base the subject upon a scientific foundation, we evaluated 31 treatment-naive HIV RNA-positive patients who were in the acute phase of the infection and 26 subjects with a negative HIV RNA test who had received ART. All sweat samples analyzed using PCR were found to be negative for HIV RNA. This finding was a scientific result supporting the statements having no scientific basis in the literature.

### Conclusion

The findings obtained in this study suggest that sweat from an HIV-infected individual that is not contaminated with blood or other body fluids has no potential for transmitting HIV infection even if serum HIV RNA level of the patient is considerably high. This result certainly does not ignore the necessity of precautions to prevent transmission of HIV during medical interventions or other approaches. General infection prevention should be precisely implemented.

**Ethics Committee Approval:** This study was approved by the Istanbul Medeniyet University, Goztepe Training and Research Hospital, Clinical Research Ethics Committee (Date: August 12, 2014; No: 2014/0121).

**Conflict of Interest:** No conflict of interest was declared by the authors.

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### Table 3: Studies on the prevalence of HIV RNA in different body fluids or secretions of HIV positive patients

| Study                        | HIV positive body fluid/secretion | Body fluid/secretion | Positive HIV RNA in body fluid/secretion % |
|------------------------------|----------------------------------|----------------------|------------------------------------------|
| Kantor et al. 2014 [7]       | 143                              | Genital secretion   | 57                                       |
| Cotten et al. 2014 [9]       | 20                               | Feces               | 12                                       |
| Liuzzi et al. 1996 [10]      | 26                               | Semen               | 25                                       |
| Balamane et al. 2010 [12]    | 47                               | Saliva              | 36                                       |
| Lourenço et al. 2014 [13]    | 57                               | Saliva              | 59                                       |
| Mohlala et al. 2005 [11]     | 23                               | Amniotic fluid      | 0                                        |
| Mohlala et al. 2005 [11]     | 23                               | Fetal cord blood    | 0                                        |
| Hanege et al. 2015 [6]       | 78                               | Cerumen             | 0                                        |
| Current study                | 57                               | Sweat               | 0                                        |

HIV: Human immunodeficiency virus.
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