Title: HIV-1 and hepatitis transmission in Sudan

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Subject Terms: HIV; Hepatitis B; Sexually transmitted disease

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HIV-1 and hepatitis B transmission in Sudan

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A seroepidemiologic survey was conducted among 773 male soldiers living in five urban locations in Sudan to study the prevalence of and risk factors for HIV-1 and hepatitis B transmission. Twenty-eight per cent of the study population were born and raised in southern Sudan, an area bordering Kenya, Zaire and Uganda, whilst 72% of the study subjects were from northern Sudan. Seventy-eight per cent of the study population had serologic evidence of past hepatitis B infection, and 13 soldiers were confirmed positive for HIV-1 antibody. All 13 HIV-positive soldiers had recently been deployed in southern Sudan. Multivariate analysis indicated an association between living in southern Sudan and both hepatitis B odds ratio 8.29 and HIV-1 infection odds ratio 14.5. Additionally, sexual relations with prostitutes odds ratio 1.5, and medical injections for schistosomiasis odds ratio 2.72 were independent predictors of hepatitis B markers in this military population. The findings of this study suggest that sexual promiscuity is a risk factor for hepatitis B transmission in Sudan. They also indicate one possible route for the spread of HIV-1 from central to northern Africa.

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Keywords: HIV, hepatitis B, sexually transmitted disease.

Introduction

Hepatitis B infection is endemic in the developing countries of northeast Africa. In contrast, the prevalence of HIV, which shares many epidemiologic characteristics with hepatitis B (1-3), is reported to be low (~7%). While the re-use of disposable needles and syringes for medical injections and prostitution have been implicated in the transmission of hepatitis B in this region (4-9), the mechanisms of viral transmission are still poorly understood. A more complete understanding of the epidemiology of hepatitis B is needed to prevent the morbidity associated with this infection, as well as to prevent the spread of HIV infection. The objective of this study was to describe the patterns of HIV-1 and hepatitis B infection among groups of male soldiers living in different regions of Sudan.

Subjects and methods

Between March 1987 and April 1988, male Sudanese soldiers stationed in the cities of Port Sudan, Kassala, Gederef, Omdurman and Juba were invited to participate in a seroepidemiologic study (Fig. 1). Juba is the largest city in southern Sudan, an area bordering Kenya, Uganda and Zaire. The four other cities are located in the predominantly Muslim provinces of northern Sudan. The north and the south of Sudan are distinct regions, both culturally and religiously. Southern Sudan is currently an area of political upheaval and military conflict. Soldiers from the north are frequently deployed in southern Sudan, and vice versa.

There was a large military population and a military medical care facility in each study site. Enlisted male soldiers presenting to outpatient clinics at these facilities were

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enrolled into the study on the basis of presentation during the time when the study site was visited. Voluntary informed consent was obtained from all subjects, and US Navy guidelines for human experimentation and the protection of human subjects were followed. Few eligible soldiers refused to participate in the study. No attempt was made to screen subjects prior to their inclusion in the study.

An epidemiologic questionnaire was completed for all study subjects by a trained Sudanese physician. Basic demographic data, including place of birth and upbringing, and the region where stationed during the previous 5 years were requested from all subjects. Soldiers reporting one of the three southern provinces as their place of birth and upbringing were considered southerners, while all other soldiers were considered northerners. Subjects were also questioned about exposure to potential risk factors for hepatitis B and HIV-I transmission. A total of 773 male soldiers participated in the study (mean age 25.8 ± 6.5 years; range, 17–58 years). Twenty-eight per cent (217/773) of study subjects were from the southern provinces, and 72 per cent (556/773) reported one of the northern provinces as their place of birth and upbringing. The mean age of study subjects from the south (25.2 ± 6.4 years) was comparable to the mean age of study subjects from the north (26 ± 6.5 years).

Soldiers raised in the south tended to be less well educated than soldiers from the north (6.4 ± 4.3 versus 8.2 ± 4.0 years of education: P < 0.001). Southern soldiers also more often reported a history of ritual scarification, tattooing and an STD (Table 1). Exposure to other potential risk factors for hepatitis B and HIV-I transmission, including previous parenteral therapy and blood transfusions, were comparable between the two groups. A prior episode of jaundice was also not reported more frequently by either group (Table 1).

Information obtained from epidemiologic questionnaires was compared with serologic test results using the chi-square test with Yates’ correction, Fisher’s exact test and two-tailed Student’s t test. Stepwise multiple logistic regression analysis was employed using the SAS computer package (Cary, North Carolina, USA). For statistical analysis of hepatitis B markers, subjects were compared as antigen positive (positive for HBsAg), seropositive (positive for any hepatitis B marker [HBsAg, anti-HBs, or anti-HBc]), and, seronegative (negative for all hepatitis B markers). Means were reported as ± 1 s.d. Significance was determined at the 0.05 level.

### Results

#### Study population

A total of 773 male soldiers participated in the study (mean age 25.8 ± 6.5 years; range, 17–58 years). Twenty-eight per cent (217/773) of study subjects were from the southern provinces, and 72 per cent (556/773) reported one of the northern provinces as their place of birth and upbringing. The mean age of study subjects from the south (25.2 ± 6.4 years) was comparable to the mean age of study subjects from the north (26 ± 6.5 years).

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### Table 1. Comparison of potential risk factors for hepatitis B and HIV-I transmission between northern and southern soldiers.

<table>
<thead>
<tr>
<th></th>
<th>Northern soldiers</th>
<th>Southern soldiers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History of</strong></td>
<td><strong>%</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Scarcification</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>Tattoo</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>Transfusion</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Jaundice</td>
<td>35</td>
<td>57</td>
</tr>
<tr>
<td>Sex with prostitutes</td>
<td>50</td>
<td>123</td>
</tr>
<tr>
<td>STD</td>
<td>28</td>
<td>83</td>
</tr>
<tr>
<td>Parenteral therapy for</td>
<td>Malanía</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

*Denominator data vary with the number of responses obtained from study subjects. *P < 0.001; *P < 0.01. STD, sexually transmitted diseases.

### Hepatitis B

Twenty-five per cent (197/773) of the entire study population was found to be antigen positive, and anti-HBs or
anti-HBc was detected in an additional 409 study subjects. Seventy-eight per cent of soldiers were, therefore, seropositive for at least one hepatitis B marker. Of HBsAg-positive samples with sufficient volumes of sera available for further testing, 8% (16/195) were positive for HBeAg and 10% (16/166) were positive for anti-HD.

The prevalence of seropositivity for hepatitis B was significantly higher among soldiers from the south (95%) when compared with soldiers from the north (72%; Table 2). The prevalence of HBsAg was also higher among southerners (28 versus 25%), but this difference was not statistically significant. There was no significant difference in the prevalence of HBeAg and anti-HD between soldiers from the north and the south.

<table>
<thead>
<tr>
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<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV-1</td>
<td>0</td>
<td>11/217*</td>
</tr>
<tr>
<td>HBsAg</td>
<td>25</td>
<td>50/217</td>
</tr>
<tr>
<td>Seropositive  (HBsAg, anti-HBs, or anti-HBc)</td>
<td>72</td>
<td>206/217*</td>
</tr>
<tr>
<td>HBcAg</td>
<td>7</td>
<td>5/60</td>
</tr>
<tr>
<td>Anti-HD</td>
<td>10</td>
<td>5/52</td>
</tr>
</tbody>
</table>

*P < 0.001. HBsAg, hepatitis B surface antigen; anti-HBs, hepatitis B surface antibody; anti-HBc, hepatitis B core antibody; HBeAg, hepatitis B e antigen; anti-HD, antibody to Delta virus.

Age-specific analysis of hepatitis B markers revealed that the pattern of hepatitis B transmission differed between individuals from the north and those born and raised in the south. In the north, the prevalence of seropositivity showed an increasing pattern of infection from 47.5%, in subjects less than 20 years of age, to more than 80% in subjects over age 39. Similarly, the prevalence of HBsAg was noted to increase with age among subjects raised in the north (Fig. 2). In contrast, hepatitis B infection was not found to increase after the age of 20 among soldiers raised in the south because nearly all soldiers (94%) under 20 years of age had serologic evidence of hepatitis B infection. Also, antigenemia was highest in the younger age groups in the south (Fig. 2).

Fifty per cent of soldiers raised in the north admitted to prior sexual relations with prostitutes compared with 57% raised in the south. Among soldiers raised in the north, the prevalence of hepatitis B markers was increased in individuals with a history of sexual relations with prostitutes when compared to soldiers denying such activity (Fig. 3). A comparable pattern of hepatitis B transmission was not found among soldiers raised in the south; however, nearly all subjects in this population had been infected with hepatitis B prior to age 20 (Fig. 2).

Multivariate analysis was performed to determine independent associations between serologic markers and potential risk factors of hepatitis B infection. Risk factors independently predictive of seropositivity for any hepatitis B marker were birth and upbringing in the south, sexual relations with prostitutes, a history of parenteral therapy for schistosomiasis and age (Table 3). Potential risk factors that were not associated with HBsAg-positivity or seropositivity in this study population included a history of blood transfusions, jaundice, ritual scarification, tattooing, and a prior STD. HBeAg and anti-HD were not related to any potential risk factors for hepatitis transmission.
An important finding of this study was the absence of HIV-1 infection among soldiers stationed exclusively in northern Sudan, whereas 5% of southerners were confirmed HIV antibody positive. The increased risk of HIV infection in the south of Sudan is consistent with the proximity of this region to Uganda, Zaire and Kenya, where HIV infection is endemic [10]. This finding suggests that HIV-1 may have been introduced into southern Sudan from neighboring countries [11-13]. A common history of sexual relations with prostitutes, often from central Africa, and prior STDs among HIV-positive soldiers suggest one possible route of HIV infection in southern Sudan. Sexual transmission would be consistent with the epidemiology of HIV infection in neighboring African countries [14-16], but a firm conclusion about the route of transmission in this group of soldiers was not possible because only 13 HIV-positive individuals were available for comparison.

Finding no HIV-1 infection among soldiers stationed exclusively in northern Sudan is comparable to the findings of previous studies conducted in this region [6-7]. These findings imply that HIV transmission may be less extensive in northern Sudan. However, HIV infection could be introduced into northern Sudan by individuals who have become infected while living in the south, as was found with two soldiers in this study.

A significantly higher prevalence of hepatitis B infection was also found among soldiers from southern Sudan compared with soldiers born and raised in the northern provinces. In the south, nearly 1% hepatitis B infection occurred before the age of 20 yrs, rather than the pattern of increasing infection with advancing age which was noted in northern Sudan. A higher prevalence of hepatitis B infection was found also among northern soldiers admitting to sexual relations with prostitutes. This finding is similar.
The independent association found in this study between hepatitis B markers and a history of parenteral therapy for schistosomiasis is consistent with the findings of other studies conducted in northern Africa [7-9]. Since the re-use of disposable needles and syringes has been reported to be a potential risk factor for HIV infection in neighbouring countries [10,14,16], medical injections could also play a role in HIV transmission in Sudan. However, the association in this study between hospitalization and HIV infection could indicate poorer health of HIV-positive subjects in this population rather than a causal relationship.

The inverse association found between education and HIV positivity is noteworthy. Other studies in Africa have reported the converse: that higher education and/or socioeconomic status is associated with HIV transmission [17,18]. A similar inverse association for hepatitis B, however, has been previously described in Sudan [16]. This inverse association may reflect differences in socioeconomic status within this military population. If the less well-educated soldiers are patronizing more promiscuous prostitutes of lower socioeconomic status, they may be at higher risk for HIV and hepatitis B infection [11].

The findings in this study suggest that sexual promiscuity is a risk factor for hepatitis B transmission in Sudan. These findings also indicate one possible route for the spread of HIV from central to northern Africa.

References