Haemorrhagic fever virus activity in equatorial Africa: distribution and prevalence of filovirus reactive antibody in the Central African Republic

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Abstract

Seroepidemiological surveys were conducted to determine the frequency and distribution of haemorrhagic fever virus (HFV) activity in the Central African Republic. Human serum specimens (4295) were collected from 5 ecologically distinct zones. Serological evidence of HFV activity was found in all the zones. The filovirus antibody prevalence (24.4%, 1051/4295) was greater than the combined prevalence for Lassa virus, Rift Valley fever virus and Crimean-Congo HFV antibody (1.1%, 45/4295; P<0.01). Evidence of filovirus activity was found in all zones: 21.5% (914/4295) of the population were seropositive for Ebola virus antibody while only 3.2% (137/4295) were seroreactive with Marburg viral antigens. Age and sex were important host-related factors influencing filovirus activity, particularly in dry grassland and moist forest communities. These communities shared many factors, but differences, such as agricultural practices and ethnic backgrounds, may also affect the risk of infection. Filovirus infections appear to occur without apparent disease. Continued investigations are needed to evaluate the true pathogenicity of the African filoviruses and the likelihood that unidentified serologically cross-reacting and non-pathogenic members of the filovirus family are active in equatorial Africa.

Introduction

The haemorrhagic fever viruses (HFV), which cause severe systemic illness with haemorrhagic diathesis, plague Africa, causing widely scattered but sporadic outbreaks, have a long history of the filoviruses is unknown. Continued investigations are needed to evaluate the true pathogenicity of the African filoviruses and the likelihood that unidentified serologically cross-reacting and non-pathogenic members of the filovirus family are active in equatorial Africa.

Materials and Methods

Survey areas

The Central African Republic occupies 620 000 km² between arid Saharan and moist equatorial Africa in the geographical centre of the continent. Sixty-one per cent of the 2.7 million inhabitants live in rural villages. The economy is predominantly agricultural; four-fifths of the population are involved in farming. The remaining one-fifth are hunter-gatherers who inhabit the tropical forest of the south-west. The economy is predominantly agricultural; four-fifths of the population are involved in farming. The remaining one-fifth are hunter-gatherers who inhabit the tropical forest of the south-west. The annual rainfall occurs in 2 seasons, April to May and August to November, and ranges from approximately 1800 mm in the south-south to 800 mm in Bira (Figure). The local vegetation varies from moist tropical rain forest in the south to semi-desert in the north. Based on climate and vegetation, the territory is easily separated into 5 ecologically distinct zones:

Figure. Map of the Central African Republic showing the main vegetation areas.

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Survey populations

Blood samples were obtained from residents of each ecological zone. Detailed sero-surveys were conducted in the moist forest areas of Nola and Ikaumba, the pre-forest grassland of Bouar and Bozo, the dry wooded grassland near Mbre, and the dry grassland of Birao. Single villages were selected in areas such as Bozo and Bangassou where ethnic cultures have been amalgamated. Additional villages were surveyed, however, in areas of greater population heterogeneity, such as Nola, Ikaumba, and Birao, where multiple ethnic groups co-exist.

Survey villages were selected on the basis of accessibility. All village residents were informed of the motive and purpose of the research and only those who agreed to participate were included. If the residents of a chosen village refused, the participation of the nearest neighbouring village was solicited.

Sample collection

Study volunteers were interviewed and a form was completed documenting the individual's name, identification number, estimated age, sex, village of residence, length of residence, ethnic group, occupation, father's name, mother's name and husband's wife's name. Venous blood was drawn aseptically from the antecubital fossa and allowed to clot overnight at 4°C. Serum was separated by centrifugation, dispensed into cryotubes and frozen in liquid nitrogen. After transport to the laboratory, the specimens were thawed, separated into aliquots, and refrozen at -20°C until re-thawed, diluted, and screened for virus reactive antibody.

Africa haemorrhagic fever viruses

The Mayinga strain (Zaire isolate) and Boniface strain (Sudan isolate) of Ebola virus (EBOV), the Musoki strain (Kenya isolate) of Marburg virus (MBGV), the Josiah strain (Sierra Leone isolate) of Lassa virus (LV), the 10200 strain (Uganda isolate) of Crimean-Congo haemorrhagic fever virus (CCHFV), and the ZH501 strain (Egypt isolate) of Rift Valley fever virus (RVFV) were used to prepare serological reagents. Except for CCHFV and RVFV, working virus stocks were prepared as clarified, suckling mouse brain homogenates.

Immunofluorescent antibody test

An indirect immunofluorescent antibody test (IFAT), using inactivated monovalent and polyvalent spot slides of acetone-fixed virus and sham-infected or similarly prepared uninfected material, was used to detect and measure HFV reactive antibody activity (JOHNSON et al., 1981). Monovalent slides were prepared by mixing uninfected cells at a 10 to 1 ratio with cells infected with a single HFV. Polyvalent slides were produced by mixing equivalent numbers of sham-infected and HFV-infected cells.

Each serum batch contained coded known HFV antibody-positive samples and was tested 'double-blind'; neither the technician who performed the test nor the one worker who evaluated the fluorescent reactions had prior knowledge of the test specimens. The survey specimens were screened for HFV reactive antibody diluted 1:16, on polyvalent slides using fluorescein isothiocyanate-conjugated goat anti-human γ-globulin (PEDERSEN et al., 1985). Virus specificity was determined by re-screening each IFAT positive serum on a monova lent slide. Sera that reacted with infected but not uninfected monovalent cell preparations at a 1:16 or greater dilution were considered positive. The antibody level was determined by titrating the IFAT reactions on monovalent cell preparations at a 1:16 or greater dilution.

Table 1. Distribution of Ebola virus and Marburg virus reactions among residents of the Central African Republic with anti-filovirus antibody

<table>
<thead>
<tr>
<th>Ecological zone</th>
<th>Survey population</th>
<th>No. with anti-filovirus antibody</th>
<th>Strain specific</th>
<th>No. positive by IFAT*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry grassland</td>
<td>509</td>
<td>35 (7-0)</td>
<td>96 (19-1)</td>
<td>26 (4-2)</td>
</tr>
<tr>
<td>Dry wooded grassland</td>
<td>37</td>
<td>2 (5-4)</td>
<td>8 (21-6)</td>
<td>3 (8-1)</td>
</tr>
<tr>
<td>Moist wooded grassland</td>
<td>156</td>
<td>5 (3-2)</td>
<td>42 (27-2)</td>
<td>16 (10-3)</td>
</tr>
<tr>
<td>Pre-forest grassland</td>
<td>73</td>
<td>1 (1-4)</td>
<td>19 (26-4)</td>
<td>2 (2-7)</td>
</tr>
<tr>
<td>Moist forest</td>
<td>187</td>
<td>16 (8-6)</td>
<td>40 (21-4)</td>
<td>1 (0-5)</td>
</tr>
<tr>
<td>Total</td>
<td>962</td>
<td>59 (6-2)</td>
<td>205 (21-3)</td>
<td>48 (5-0)</td>
</tr>
</tbody>
</table>

*Indirect fluorescent antibody test: titres 1:16–1:4096. Virus strain-specific reactions, specimens which reacted with only one filovirus; EBOV group-specific reactions, specimens which reacted with both Ebola virus strains (EBOZ and EBO); filovirus family-specific reactions, specimens which reacted with both Ebola virus (EBOV) and Marburg virus (MBVG). Numbers in parentheses represent precentages of seropositives demonstrating virus strain-specific or cross-reacting IFAT antibody.
Filovirus antibody prevalence

A recent serosurvey in the Central African Republic reported high antibody prevalence against Ebola and Marburg viruses in the Central African Republic. The distribution of filovirus IFAT titres (Table 2) was similar to that in areas of Central and West Africa where HFV activity was confirmed by virus isolation from clinical cases (McCormick et al., 1987). Two-thirds (1099/1671) of the positive serological reactions had relatively low titres (<64), but the remainder often reached 2048. The distribution of antibody titre differed for the 3 filovirus reaction patterns; 43% (48/1124) of the EBOV group had only 15-5% (85/547) of the strain and family specific reactions had high titres (P<0.01). The endpoint dilutions for EBOVZ and EBOVS reactions in the EBOV group-specific specimens were within 2- to 4-fold dilutions. Monospecific MBGV sera tended to have high titres; 33% (16/48) of the monospecific MBGV sera had titres ≥128.

Age and sex were important host-related factors influencing filovirus antibody prevalences, particularly in the case of EBOV. The prevalence of high titre (>128) EBOV antibody increased with age. Older females and males had higher EBOV antibody prevalences than younger people of the same sex (Table 3). Young females had a higher prevalence than young males; the female and male prevalences become equivalent in the 21-40 years age group (P=0.45). Although EBOV reactive antibody prevalences were higher for females than for males in all ecological zones except the dry wooded grasslands, statistically significant differences (P<0.01) between the sexes were observed in the dry grasslands only (P<0.01) (Table 4). Antibody prevalence rates were consistently higher in older than younger populations (Table 5). Stat-

Table 2. The distribution of filovirus-specific antibody titres in the indirect fluorescent antibody test (Central African Republic)

<table>
<thead>
<tr>
<th>Test antigens</th>
<th>No. positive</th>
<th>Reciprocal antibody titres</th>
<th>IFAT reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32-64</td>
<td>128-256</td>
<td>512-1024</td>
</tr>
<tr>
<td>Filovirus stain specific&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EBOVZ</td>
<td>59</td>
<td>7 (11:9)</td>
<td>2 (3:4)</td>
</tr>
<tr>
<td>EBOVS</td>
<td>206</td>
<td>29 (14:1)</td>
<td>1 (0:5)</td>
</tr>
<tr>
<td>MGBV</td>
<td>48</td>
<td>13 (27:1)</td>
<td>2 (4:7)</td>
</tr>
<tr>
<td>Ebola virus group specific&lt;sup&gt;c&lt;/sup&gt;</td>
<td>562</td>
<td>193 (34:3)</td>
<td>26 (4:6)</td>
</tr>
<tr>
<td>EBOVZ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EBOVS</td>
<td>562</td>
<td>214 (38:1)</td>
<td>28 (5:0)</td>
</tr>
<tr>
<td>Filovirus family specific&lt;sup&gt;c&lt;/sup&gt;</td>
<td>60</td>
<td>9 (15:0)</td>
<td>2 (3:4)</td>
</tr>
<tr>
<td>EBOVZ</td>
<td>85</td>
<td>16 (18:8)</td>
<td>3 (3:5)</td>
</tr>
<tr>
<td>EBOVS</td>
<td>89</td>
<td>89 (100)</td>
<td>0 (–)</td>
</tr>
</tbody>
</table>

<sup>a</sup>EBOVZ and EBOVS=Ebola virus strains Z and S; MGBV=Marburg virus.

<sup>b</sup>Numbers in parentheses are percentages.

<sup>c</sup>Specificities are described in Table 1; note a.

<table>
<thead>
<tr>
<th>Survey population</th>
<th>Sex and age (years)</th>
<th>No. positive (≥1:128)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>EBOV</td>
<td>MGBV</td>
</tr>
<tr>
<td></td>
<td>1-20</td>
<td>927</td>
<td>73 (7:9)</td>
</tr>
<tr>
<td></td>
<td>≥21-40</td>
<td>672</td>
<td>76 (11:3)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>333</td>
<td>50 (15:0)</td>
</tr>
<tr>
<td></td>
<td>1-20</td>
<td>1186</td>
<td>43 (3:6)</td>
</tr>
<tr>
<td></td>
<td>≥21-40</td>
<td>500</td>
<td>55 (9:8)</td>
</tr>
<tr>
<td></td>
<td>≥41</td>
<td>400</td>
<td>38 (9:5)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Numbers in parentheses are percentages. EBOV=Ebola virus, MGBV=Marburg virus.
results supporting earlier findings indicating that EBOV
cimens we examined exhibited EBOV strain specific re-
cal responses in humans (JOHNSON et al., 1978; WEBB et
exposure leads to broad filovirus group specific serologi-
sity, reacting with both the Zaire and Sudan EBOV
strains. These observations are the first field serosurvey
identified in our study expressed EBOV group speci-
al., 1983). The majority of the filovirus seropositives
recorded consistently for high risk groups in diverse eco-
logical zones of central Africa since 1984
modes of exposure
less pathogenic in their natural settings than commonly
disease, suggesting that the African tiloviruses may be
The infections appear to occur without apparent overt
Africa is influenced by sex and/or age related factors.
activity was unexpected (Table 1), though numerous
EBOVZ strain specific responses have been reported by
others (BLACKBURN et
al., 1982; IVANOFF et
al., 1982).
The concept of mild immunizing EBOV infections has
difficult to accept in view of the high mortality and
very low incidence of mild or subclinical infections ob-
served during the Zaire epidemic (JOHNSON, 1978).
The virus specific reactions in our study may reflect
distinct EBOV strain activity. If these antibodies are the
results of a single exposure to one of the African EBOV
strains, the resulting antibody response is of low titre
(Table 2; <1:64 in 85% of subjects). Furthermore, the
high EBOV group reactive antibody prevalence, which
was greater than would be expected from the fraction of
monospecific or EBOV strain specific reactions in the
population tested, suggests that the EBOVs do not circu-
late independently and that our study population shares
common risk factors for exposure to the 2 viruses.
An alternative interpretation of our data could be that
EBOV infections induce the formation of group reactive
antibody of varying specificities depending upon the
virus strain, nature of exposure, and host reactivity.
Virus specific reactions would, therefore, reflect a past
infection in which the heterologous strain responses have
decayed unequally, and EBOV group reactives would
represent a recent infection. The latter interpretation,
which we favour, is supported by the observation that
non-fatal EBOV infections during the Zaire outbreak fre-
historically significant differences were observed also be-
tween younger and older inhabitants of the dry grassland
(P<0.01) and moist forest (P<0.05). There was no stat-
istically significant difference between young and old
human populations in the MBGV specific seropositive
populations.
Discussion
Our results demonstrated that filovirus infections were
common among residents of the Central African Repub-
lic. Virus activity in diverse environments of equatorial
Africa is influenced by sex and/or age related factors.
The infections appear to occur without apparent overt
disease, suggesting that the African filoviruses may be
less pathogenic in their natural settings than commonly
thought. Most human filovirus disease has been de-
scribed in epidemic settings, which may involve atypical
modes of exposure (SIEGERT, 1970; JOHNSON, 1978;
Serological evidence of filovirus activity has been re-
corded consistently for high risk groups in diverse eco-
ological zones of central Africa since 1984 (MEUNIER et
al., 1987). The majority of the filovirus seropositives
identified in our study expressed EBOV group speci-
city, reacting with both the Zaire and Sudan EBOV
strains. These observations are the first field serosurvey
results supporting earlier findings indicating that EBOV
exposure leads to broad filovirus group specific serolog-
ical responses in humans (JOHNSON et al., 1978; WEBB et
al., 1978, RICHMAN et al., 1983).
The finding that only 27-4% of the seropositive speci-
cimens we examined exhibited EBOV strain specific re-
Table 4. Sex distribution of individuals with high titres (≥1:128) in the indirect fluorescent antibody test against
Ebola and Marburg viruses in the different ecological zones of the Central African Republic

<table>
<thead>
<tr>
<th>Ecological zone</th>
<th>Sex</th>
<th>Total surveyed</th>
<th>EBOV</th>
<th>No. positive (≥1:128)*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry grassland</td>
<td>Female</td>
<td>1071</td>
<td>128 (10-0)</td>
<td>11 (1-0)</td>
<td>139 (12-6)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>1099</td>
<td>85 (7-7)</td>
<td>7 (0-6)</td>
<td>92 (8-4)</td>
</tr>
<tr>
<td>Dry wooded grassland</td>
<td>Female</td>
<td>99</td>
<td>3 (3-0)</td>
<td>0 (--)</td>
<td>3 (3-0)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>156</td>
<td>5 (3-2)</td>
<td>1 (0-6)</td>
<td>6 (3-8)</td>
</tr>
<tr>
<td>Moist wooded grassland</td>
<td>Female</td>
<td>226</td>
<td>17 (7-2)</td>
<td>3 (1-3)</td>
<td>20 (8-8)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>295</td>
<td>13 (4-4)</td>
<td>3 (1-0)</td>
<td>16 (5-4)</td>
</tr>
<tr>
<td>Pre-forest grassland</td>
<td>Female</td>
<td>195</td>
<td>7 (3-5)</td>
<td>4 (2-0)</td>
<td>11 (5-6)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>210</td>
<td>1 (0-5)</td>
<td>1 (0-5)</td>
<td>2 (1-0)</td>
</tr>
<tr>
<td>Moist forest</td>
<td>Female</td>
<td>381</td>
<td>41 (10-8)</td>
<td>1 (0-3)</td>
<td>42 (11-0)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>418</td>
<td>32 (7-6)</td>
<td>0 (--)</td>
<td>32 (7-6)</td>
</tr>
</tbody>
</table>

*Numbers in parentheses are percentages. EBOV=Ebola virus, MBGV=Marburg virus.

Table 5. Age distribution of individuals with high titres (≥1:128) in the indirect fluorescent antibody test against
Ebola and Marburg viruses in the different ecological zones of the Central African Republic

<table>
<thead>
<tr>
<th>Ecological zone</th>
<th>Age (years)</th>
<th>Total surveyed</th>
<th>EBOV</th>
<th>No. positive (≥1:128)*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry grassland</td>
<td>1-20</td>
<td>1286</td>
<td>67 (5-2)</td>
<td>7 (0-5)</td>
<td>74 (5-8)</td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>844</td>
<td>131 (15-5)</td>
<td>10 (1-2)</td>
<td>141 (16-7)</td>
</tr>
<tr>
<td>Dry wooded grassland</td>
<td>1-20</td>
<td>108</td>
<td>3 (2-8)</td>
<td>0 (0-0)</td>
<td>3 (2-8)</td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>137</td>
<td>5 (3-6)</td>
<td>1 (0-7)</td>
<td>6 (4-4)</td>
</tr>
<tr>
<td>Moist wooded grassland</td>
<td>1-20</td>
<td>152</td>
<td>7 (4-6)</td>
<td>2 (1-3)</td>
<td>9 (5-9)</td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>370</td>
<td>23 (6-2)</td>
<td>4 (1-1)</td>
<td>27 (7-3)</td>
</tr>
<tr>
<td>Pre-forest grassland</td>
<td>1-20</td>
<td>224</td>
<td>7 (3-1)</td>
<td>1 (0-4)</td>
<td>8 (3-6)</td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>196</td>
<td>9 (4-6)</td>
<td>1 (0-5)</td>
<td>10 (5-1)</td>
</tr>
<tr>
<td>Moist forest</td>
<td>1-20</td>
<td>360</td>
<td>25 (6-9)</td>
<td>0 (0-0)</td>
<td>25 (6-9)</td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>432</td>
<td>53 (12-2)</td>
<td>1 (0-2)</td>
<td>54 (12-5)</td>
</tr>
</tbody>
</table>

*Numbers in parentheses are percentages. EBOV=Ebola virus, MBGV=Marburg virus.
both EBOV and MBGV sero-reactivity was also unexpected. This may be a consequence of multiple filovirus exposures among a small group of Central African Republic inhabitants. The distribution of MBGV antibody titres may support the possibility of recurring filovirus infections. MBGV reactions accompanied EBOV antibodies in a higher proportion than expected from the number of EBOV or MBGV monospecific reactors in the study group. In contrast to the situation with EBOV group reactions, none of the filovirus family reactions had high titres of MBGV reactive antibody, while 33% (16/48) of the MBGV specific responses were greater than, or equal to, 128. This may reflect the lack of a detectable serological relationship between MBGV and EBOV (WEBB et al., 1978; RICHMAN et al., 1983).

The frequency of low filovirus antibody titres often observed in African HFV sero-surveys deserves comment; 0-3% (3/99) and 0-5% (1/200) of human samples collected in non-endemic areas, France and Panama (J. P. Gonzalez et al., paper in preparation; VAN DER GROEN et al., 1978), respectively, had low antibody titres to Ebola virus. These low prevalences and low titre (≤1:64) reactions in populations without an African exposure history suggest that some of the low titre filovirus sero-reactive sera observed in our survey were false-positives. However, the distribution of EBOV IFAT titres (Table 2) is similar to that observed during sero-surveys in regions of Central and West Africa where HFV activity has been confirmed by virus isolation from clinical specimens (MCCORMICK et al., 1987). Our conclusion, that filovirus activity has occurred in the Central African Republic, is unchanged by basing it on only high titre (>128) IFAT1 reactions. At least 11.2% of the female and 6-8% of the male populations have been exposed (Table 3). Age specific prevalence rates for the 1–20 years old age group indicate that young females are exposed more frequently than are males of the same age group (P<0.01). The statistically significant differences between female and male EBOV reactive antibody prevalences observed in our study are not unique, similar observations having been made during sero-epidemiological studies by MUNYEMBA, BERGMANN, et al., 1983.

Filovirus activity in the Central African Republic was not limited to a specific habitat. Serological evidence of human infection was found in all ecological zones, though MBGV infections were rare in the dense forest. This contrasts with the previous report of EBOV antibody being confined to forest populations (JOHNSON, 1959; SMITH, 1978; VAN DER GROEN et al., 1978). The observation that filovirus family specific seropo-positives occurred among grassland populations where EBOV and MBGV co-exist may indicate the presence of a unique human population expressing cultural or behavioural risk factors for both EBOV and MBGV infections or filovirus re-infections (Table 1). The variation in antibody prevalence between ecological zones may indicate the importance of host-related factors in regulating human filovirus exposures rather than differential circulation of filoviruses. Unfortunately, the putative risk factors were not identified due to low frequency (≤2-4%) of filovirus family specific seropo-positives among diverse grassland populations.

Sex and/or age were clearly identified as important risk factors for filovirus infections in both dry grassland and moist forest communities (Tables 4 and 5). Communities in these two ecological zones differ from those in the centrally located wooded grasslands. Rural communities of the less populated far northern and southern zones are geographically isolated with little influence from outside factors, and people in these communities interact closely with their immediate natural environment without causing dramatic changes. The high filovirus prevalence in females (Table 4) suggests that filovirus exposure may be a notable health risk for women living in the Central African Republic. Subsistence activities are a primary responsibility of rural women; men spend less time on them (HEWITT, 1991). Young and old women share a close association with the family compound and fields. Males (>6 years old) associate less with the family compound or crops (MURDOCK & PROVOST, 1973). The high filovirus prevalence among young women (Table 5) suggests that filovirus exposure may occur within the family compound. The filovirus antibody in guinea-pigs maintained as a supplemental food source in kitchen huts in Zaire (STANS FIELD et al., 1982) may support this view.

The significance of similar antibody prevalences in the remote northern and southern regions of the Central African Republic must be interpreted carefully. The grassland and forest zones share many factors, but there are significant differences in agricultural practices and ethnic backgrounds, which may also affect risk (BAUER & BERGMANN, 1983). The grassland survey population consisted of cultivators and/or pastoralists. The forest communities were comprised of agriculturalists and hunter-gatherers; subsistence farmers infrequently hunt and hunter-gatherers seldom cultivate vegetable foods.

Although our sero-epidemiological surveys clearly documented non-fatal filovirus infections, the results do not resolve the paradox of significant antibody prevalence for the highly virulent filoviruses without demonstrable disease in Central Africa. Continued surveillance and intense epidemiological investigations to evaluate the true pathogenicity of the African filoviruses and the likelihood that unidentified, serologically cross-reacting and non-pathogenic members of the filovirus family are present in the region (MEUNIER et al., 1987). The recent isolation of a presumptive Asian filovirus from Philippine monkeys (Macaca fascicularis) emphasizes the possibility that additional filoviruses may be active also in sub-Saharan Africa (JAHRLING et al., 1990); these viruses could resemble the newly isolated strain in being serologically cross-reactive with, but distinguishable from, the Zaire and Sudan EBOV strains and less pathogenic for man. Based upon our results, the search for Ebola and Marburg viral infections in central Africa should be conducted in non-urban moist forest and dry grassland communities where serological evidence suggests frequent but non-fatal infections. The probability of successfully resolving the paradox may be increased by focusing upon defining the relationship between filovirus sero-reactivity and sex-specific subsistence strategies practised in equatorial Africa.

References


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**Announcement**

**The Tropical Health and Education Trust**

Fellows of the Society have always been actively involved in many tropical countries in establishing and developing medical schools and other training institutions. But some of these schools, particularly in poorer African countries, face severe hardships. Students have no books, there is no foreign exchange for journals, equipment lacks spares, research cannot be supported and external aid is directed towards primary health care.

The Tropical Health Education Trust has started to relieve, with support from many individuals, Trusts and organizations, some of these disadvantages.

Basic books have been sent to all the rural hospitals in two African countries, sets of books have been given for students in a number of others. Links between medical schools overseas and home departments have been started with fellowships for students in training and research methods also.

The Tropical Health and Education Trust aims to extend support like this to more countries, hospitals, medical schools and students and needs funds to do it: Fellows of the Society who would like to take this opportunity to help our colleagues overcome some of their obstacles can do so through a single gift, a four-year or a deposited covenant, or even through a legacy.

Trustees include: R. M. Anderson, K. P. W. I. McAdam, E. H. O. Parry (Chairman), D. A. Warrell.

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