Serological surveillance of brucellosis and Q fever in cattle in the Central African Republic

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Abstract

No data are available concerning the seroprevalence of brucellosis in Central African Republic (CAR) and the last report concerning the seroprevalence of Q fever in CAR is from 1995. The aim of our study was to determine the prevalence of these diseases in CAR, especially in Zebu cattle. We used the Rose Bengal Plate Test to test 2032 bovine serum samples for antibodies to Brucella spp. and an indirect immunofluorescence assay to test 784 bovine serum samples for antibodies to Coxiella burnetii (the species responsible for Q fever). The mean seroprevalences of antibodies to Brucella and Coxiella were 3.3 and 14.3%, respectively. Significant differences were found between regions and herds for both diseases. However, relation with differences of climate or vegetation were not evident. Therefore, further data are necessary to better understand the epidemiology of these diseases in CAR and evaluate losses to the farmers.

Keywords: Cattle; Central African Republic; Brucellosis; Q fever

1. Introduction:

Brucellosis is an enzootic infection caused by bacteria from the Brucella genus. It is responsible mainly for abortion or prematurity in cattle, sheep and goats (Thimm and Wundt, 1976). Humans can be accidentally infected following close contact with infected animals or by consuming infected animal products such as unpasteurized milk, unpasteurized milk products and raw meat (Thimm and Wundt, 1976). Humans can also be infected via skin abrasions or by inhaling airborne particles from animal manure.

Q fever, a zoonosis caused by Coxiella burnetii, is found in a variety of birds, wild and domestic mammals.
mals and arthropods worldwide (Kaplan and Bertagna, 1955; Maurin and Raoult, 1999). This bacterium is transmitted to mammals mainly during parturition (Welsh et al., 1958), and high concentrations of C. burnetii are found in the placenta, amniotic fluid and other parturition products of sheep, cattle and goats. In most countries, humans are infected with C. burnetii by direct contact with aerosols generated during parturition of domestic ungulates. Nevertheless, contamination may occur some time after parturition as C. burnetii is strongly resistant to desiccation and environmental degradation. Although domestic ungulates seem to constitute the main reservoir for the bacterium, other animals such as dogs (Willerberg et al., 1980, Buhariwalla et al., 1996), cats (Pinsky et al., 1991, Marrie et al., 1985) and pigeons (Stein and Raoult, 1999) have been implicated in rare cases. It has been suggested that humans can become infected following the consumption of unpasteurized milk (Fishbein and Raoult, 1992).

The Central African Republic (CAR) is a country with three million inhabitants and nearly three million zebu cattle. The economic impact of cattle breeding is very important in the CAR. Zebu breeding sites are mostly located in the Savannah areas in northern CAR; very few cattle live in the south-west, which is mainly covered with tropical rain forests. Much has been written about viral infections, both in humans and animals, in CAR during the past decades. However, very little is known about enzootic bacterial infections in the CAR. No data exist concerning the prevalence of brucellosis in the CAR. Serological studies indicated that humans could be infected with C. burnetii in CAR (Gonzalez et al., 1985; Tissot Dupont et al., 1995); some cases of C. burnetii infection have been reported in the CAR, but the only reports concerning the seroprevalence of antibodies to C. burnetii in animals is very old (Maurice and Gidel, 1968). We carried out a serological study to determine the prevalence of these diseases in CAR, especially in zebu cattle, and to evaluate their potential economic impact.

2. Materials and methods

2.1. Blood samples

The National Agency of Breeding Development collected a large number of bovine serum samples each year from 1998 to 2000 for the surveillance of Rinderpest virus. Blood samples were taken from each animal of different herds of Zebu cattle from the Savannah regions (north, east, center and west) of CAR. Some randomly chosen serum samples were given to the Pasteur Institute of Bangui for serological testing. The age, gender, region and herd were recorded when possible. Each region contained one or several herds (Table 1).

Table 1
Prevalence of antibodies to Brucella spp. and Coxiella burnetii in each breeding area

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of herds</th>
<th>Brucella spp</th>
<th></th>
<th>Coxiella burnetii</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vakaga</td>
<td>6</td>
<td>157</td>
<td>24</td>
<td>6.4</td>
<td>80</td>
</tr>
<tr>
<td>Bamingui Bangoran</td>
<td>2</td>
<td>159</td>
<td>1</td>
<td>0.6</td>
<td>99</td>
</tr>
<tr>
<td>Nana Gribbi</td>
<td>1</td>
<td>64</td>
<td>0</td>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>Haute Kotto</td>
<td>1</td>
<td>21</td>
<td>1</td>
<td>4.8</td>
<td>21</td>
</tr>
<tr>
<td>Ondoa</td>
<td>3</td>
<td>319</td>
<td>20</td>
<td>6.3</td>
<td>50</td>
</tr>
<tr>
<td>Ouham</td>
<td>2</td>
<td>120</td>
<td>2</td>
<td>1.6</td>
<td>59</td>
</tr>
<tr>
<td>Ouham Pendé</td>
<td>7</td>
<td>433</td>
<td>10</td>
<td>2.3</td>
<td>175</td>
</tr>
<tr>
<td>Kemo</td>
<td>1</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Mbomou</td>
<td>1</td>
<td>164</td>
<td>7</td>
<td>4.3</td>
<td>18</td>
</tr>
<tr>
<td>Basse Kotto</td>
<td>3</td>
<td>229</td>
<td>0</td>
<td>0</td>
<td>49</td>
</tr>
<tr>
<td>Ombella Mpyoko</td>
<td>1</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Nana Mambéré</td>
<td>2</td>
<td>70</td>
<td>4</td>
<td>5.7</td>
<td>70</td>
</tr>
<tr>
<td>Mambéré Koudé</td>
<td>1</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>2032</td>
<td>69</td>
<td>3.3</td>
<td>744</td>
</tr>
</tbody>
</table>
2.2. Brucellosis test—serodiagnosis of brucellosis by the Rose Bengal antigen card test

The Rose Bengal test (or buffered antigen test) was used to detect Brucella-specific agglutinins (Brucella melitensis, Brucella abortus bovis and Brucella suis). The tests were performed according to the manufacturer’s recommendations (BioMérieux, France). When no agglutination was observed, the serum was considered to be negative. When even slight agglutination was observed, the serum was considered to contain specific Brucella antibodies.

2.3. Serodiagnosis of Q fever by the indirect fluorescent antibody test (IFA)

Zebu serum samples (diluted 1/50 in phosphate buffered saline) were tested for antibodies to C. burnetii by an immunofluorescence test (C. burnetii-Spot IIF, BioMérieux, France); the fluorescence test was performed as for human serum with, in addition, FITC-conjugated goat anti-bovine IgG (Sigma Laboratories, Germany). All serum samples that reacted at a dilution of 1/50 or more were considered to be positive.

2.4. Statistical analysis

The 95% confidence intervals of the seroprevalence rates were calculated taking into account the clustering of data by herds at the area level, using the Stata 7.0 software (Stata Corp., USA).

Because of the small size of some herds and of the within herd correlation of the risk of seropositivity, we used exact randomization tests to compare seroprevalence rates between areas and between herds. These tests are based on random sampling from arrangements of the data and provides a fully valid $P$-value (Manly, 1991). The Khi-2 values calculated from the observed data were compared to the Khi-2 values calculated from 1000 simulated samples with a structure identical to the actual sample, i.e. the same sample sizes at the herd and area levels. In these virtual samples, the seropositivity was allocated with a probability equal to the overall observed seroprevalence rate. Observed Khi-2 values above the 95th and the 99th percentiles of simu-
lated $Khi^2$ values were interpreted as p-values below 0.05 and 0.01, respectively. The seroprevalence rates between herds in a given area were compared by the Fisher exact test.

3. Results

Sixty-eight of the 2032 (3.4%, 95%CI: 2.0–4.0%) serum samples tested were found to be positive for antibodies to *Brucella* spp; the seroprevalence differed significantly according to regions ($P < 0.01$) and herds ($P < 0.01$) (Table 1, Fig. 1).

One hundred and twelve of the 784 (14.3%, 95%CI:7.8–20.8%) serum samples tested presented antibodies to *C. burnetii* at a titer of 50 or more. The seroprevalence of antibodies to *C. burnetii* differed significantly according to regions ($P < 0.01$) (Table 1). The seroprevalence of antibodies to *C. burnetii* was highest in the Nana Grebizi (35.9%), Haute Kotto (28.6%) and Vakaga (26.2%) regions, and the lowest in the Kemo region (0%, but only 19 animals tested). Significant differences were also observed between herds in a given region ($P < 0.01$). In the Osham Pendé region, the prevalence varied between 0/20 in one herd and 14/63 in another and in the Vakaga region, the prevalence varied between 0/11 and 20/46.

The seroprevalence of brucellosis and Q fever did not differ significantly between males and females.

4. Discussion

This is the first study concerning brucellosis in cattle in the CAR. We found that the mean seroprevalence of this disease in zebus was just 3.3%. This is lower than in most African countries, 6.6% in Ghana (Kubuafor et al., 2000) or 12.3% in Uganda (Thimm and Wundt, 1976). Therefore, brucellosis might be a minor problem for the cattle breeds living in the CAR. It is difficult to determine the prevalence of brucellosis in other domestic ungulates (goats or sheep) in the CAR as these animals live in small herds scattered throughout the country and are not slaughtered in slaughterhouses.

A little more was known about the prevalence of *C. burnetii* in the CAR. In the 1950s and 1960s, 22% of cattle, 36% of sheep, 22% of goats and 28% of horses were positive for *Coxiella* antibodies according to a micro-agglutination test (Maurice and Gidel, 1968). A serological study performed in Bangui has shown that more than 16% of individuals had antibodies to *C. burnetii* (Belec et al., 1993). Our study shows striking differences in the prevalence between different regions of the CAR. The seroprevalence was highest in the north-east of the country. These results confirm those obtained thirty years before by Maurice and Gidel who found that animals from the Ouaka area were more infected than those from the Nana-Manbere area (Maurice and Gidel, 1968). This is also the driest area of the CAR. The dry atmosphere might enhance the dispersion of aerosols, thus explaining why the risk of infection for the cattle is higher than in other regions. If this is true, Q fever is probably also frequent in humans living in this region, particularly among farmers. Further studies are needed to see whether there is a correlation between the seroprevalence in cattle and in humans. However, in the Bamingui–Bangoran region, which is located between the Vakaga and the Nana Grebizi regions, only 6% of animals tested positive; and in the south west regions of Manbéré Kadé and Ondella Mpkok, where the climate is more humid, 15% of animals tested positive. Furthermore, the seroprevalence varied greatly between herds in given regions. For example, in the Vakaga region no animals were found positive in four herds whereas positive animals were prevalent in two other herds (1/2 and 20/46). Therefore, inter-region differences may be due to differences between herds rather than to climate differences, and other factors than enhanced aerosol transmission, such as wildlife reservoir or external parasites, could be implicated in some areas.

Epidemiological studies are now required to explain the differences in seroprevalence between herds and to evaluate the loss for the farmers. Finally, clinical studies should be carried out to determine the prevalence of these diseases in humans and to provide information for physicians.

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References


