Seroprevalence of *Bartonella henselae* in population from eastern China and analysis of risk factors

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Abstract

Background

To investigate the seroprevalence of *Bartonella henselae* and analyze the risk factors, which will provide baseline data for *Bartonella* infection control and prevention.

Methods

We collected blood samples between December 2005 and November 2006 from 8 sites throughout Zhejiang Province, China. Samples were detected for antibodies against *B. henselae* using indirect immunofluorescence test. Chi-square tests and logistic regression analysis of *B. henselae* seroprevalence among sites, genders, age groups and exposure of dog bites were conducted using the Statistical Package for the Social Sciences.

Results

In total, 19.60% of blood samples were seropositive to *B. henselae* and positive rates in Hangzhou, Tiantai, Longyou, Huzhou, Jiangshan, Chun’an, Longquan, Linhai were 32.38%, 25.96%, 22.00%, 15.38%, 2.00%, 16.09%, 15.38%, 10.71% respectively.

Conclusions

*B. henselae* antibody spread widely throughout Zhejiang Province and the seropositive rate among people exposed to dog bites was significantly higher than that among other people, which indicated that dog bites may be risk factors to *Bartonella* infection.

Keywords *Bartonella henselae*; seroprevalence; risk factor
**Background**

The genus *Bartonella* is an oxidase-negative, fastidious, gram-negative hemotropic bacillus that infect the erythrocytes and endothelial cells of their hosts [1]. More than 20 species or subspecies of *Bartonella* have been described, and at least 12 of them are recognized as human pathogens [2]. The diverse species infects a variety of mammalian hosts and arthropod vectors causing a broad spectrum of diseases.

In 1990, a new species now called *B. henselae* was shown to cause bacteremia and bacillary angiomatosis in patients with the acquired immunodeficiency syndrome (AIDS)[3,4]. *B. henselae* can cause both bacillary angiomatosis [5, 6] and endocarditis [7, 8], but is most commonly associated with cat scratch disease (CSD) [9, 10], an illness which has also been attributed to *Bartonella clarridgeiae* [11].

According to clinical reports, the number of *Bartonella* infection patients from Zhejiang Province is secondary largest in China. However, there were no epidemiological investigation about prevalence of *Bartonella* infection and its risk factors in Zhejiang Province. Because *B. henselae* was difficult to culture, we detected *B. henselae* antibody using indirect immunofluorescence test (IIFT) in population from Zhejiang Province and analyze risk factors.

**Methods**

**Blood samples**

From December 2005 to November 2006, blood samples were collected in some sites (Hangzhou, Tiantai, Longyou, Huzhou, Jiangshan, Chun’an, Longyou, and Linhai) of Zhejiang Province. Part of blood samples were from patients in rabies clinic and the other
were from blood donors. Patients and donors were requested to provide information with regard to age, gender, residence, whether they exposed to dog bites and degree. In addition, our aims were clearly explained to each person when samples were collected.

**Serological testing**

A commercially available *B. henselae*–based indirect immunofluorescence test kit (Euroimmun, Order No. FI219b-1005G) was used to assess the presence of IgG antibodies against *B. henselae*. After the samples were diluted 1:100, 1:320, 1:1000, 1:3200 and 1:10000 in PBS-Tween (afforded in the test kit), the IFA assay was conducted following the manufacturer’s protocol. Positive and negative controls (afforded in the test kit) were used. Specific immunofluorescence was observed using a fluorescence microscope at magnification of \( \times 40 \) and \( \times 200 \). According to manufacturer, Positive reaction at 1:320 was the indication of an infection and IgG antibody titers of 1:1000 or higher are judged as an indicator for acute infection.

**Date analysis**

Chi-square tests and logistic regression analysis of *B. henselae* seroprevalence among sites, genders, age groups and exposure of dog bites were conducted using the Statistical Package for the Social Sciences (SPSS 11.0, Chicago, IL). The dependent variable in the logistic regression was seroprevalence status and the independent variables were site, gender, age, exposure, site \( \times \) exposure. The method of logistic regression was forward-conditional. The stepwise probability for entry was 0.05 and for removal was 0.10. The classification cut off was 0.5 and the maximum number of iterations was 20. Omnibus tests of model coefficients were also conducted.
Results

A total of 556 blood samples were collected from 8 sites throughout Zhejiang Province. Of these, 317 were male and 239 were female (Table 1). About 205 serum samples were from people bitten by dogs and 351 samples were from donors.

Overall, 19.60% (109/556) of blood samples were seropositive (Table 1). Seroprevalence of *B. henselae* varied significantly among sites (2.00% to 32.38% among sites [X^2=28.220, P<0.001]), exposure group and control group (27.80% in exposure group and 14.81% in control group [X^2=13.856, P<0.001]). Seroprevalence of *B. henselae* was similar among male (18.61%, n=317) and female (20.92%, n=239) population (X^2=0.461, P=0.497>0.05). People were divided into 4 groups according to age, seropositive rate of *B. henselae* in <15 years old group, 15-44 years old group, 45-59 years old group, and >59 years old group were 17.78% (5/18), 18.27% (59/323), 18.42% (28/152), 26.98% (17/63) respectively.

Chi-square in omnibus tests of model coefficients was 60.326(P=0.000<0.05). The overall correct percentage was 81.5%. Variables in the equation included site, exposure and site × exposure. The wald of site × exposure, site, and exposure were 25.477 (P=0.001), 20.090 (P=0.005), and 16.174 (P=0.024) respectively.

Discussion

*Bartonella* spp. were detected in domestic cats [12], small mammals and *Haemaphysalis longicornis* and *Ixodes sinensis* ticks [13] from Zhejiang Province. People have chances to contact with cats, dogs, small mammals and some vectors on their body. *Bartonella* spp. can be transmitted through scratch and bites of cats or dogs. Some vectors can also transmit *Bartonella*, such as fleas, tick, et al. Therefore, it is necessary to study the prevalence of
Bartonella in people throughout Zhejiang Province and analyze risk factors.

In our study, the average positive rate was 19.60%, which was similar to an investigation in another province of China. A similar 14.28% rate of seropositivity to B. henselae antigen was found in a previous study conducted with healthy population in Yunnan Province, China[14]. But there are also some contrasting results, Yang [15] found 34.5% seropositive rate of B. henselae among healthy population from Beijing City, China. In Japan, Kikuchi[16] reported a B. henselae specific IgG seroprevalence of 3.1% among adult patients with cardiovascular disease and 10.9% in a high-risk population of healthy veterinary students, of whom 0.8% had positive results of serologic testing for B. henselae specific IgM. These differences may attribute to the variation of different geographic position. In different districts, the density of cats and dogs is different.

The finding of B. henselae antibody in all 8 study sites indicates that bartonellae are broadly present in Zhejiang Province. The prevalence varied among sites within the province. Hangzhou, Tiantai, and Longyou had the highest prevalence. However, the exposure rate to dog bites may influence our results. The exposure rate to dog bites in Hangzhou was significantly higher than any other sites. What’s more, site×exposure entered the equation in logistic regression analysis, which means site and exposure correlated each other.

Seroprevalence of B. henselae in individuals bitten by dogs was significantly higher than that among control group. The reason may be that people exposed to dog bites have more chances to contact with dogs or vectors. We also speculated that there was connection between dog bites and seropositivity, which suggest the need to determine whether Bartonella can be transmitted by dog bites.
As we all know, cat scratches and flea bites are the well known risk factors related to *B. henselae* infection. Children and young people have a much higher risk of being exposed to cat scratches or flea bites compared to elderly people. But we are unexpected the seroprevalence of *B. henselae* among age groups was not significantly different. We speculated that influence factors may include group method of age and sample sizes.

**Conclusions**

*Bartonella* infection is difficult to diagnose, especially when it manifests as bacteremia, which is usually accompanied by nonspecific symptoms, such as fever. So only few physicians understood and diagnosed them. Our study confirmed that antibody of *B. henselae* spread widely in Zhejiang province and the seroprevalence of *B. henselae* in people exposed to dog bites was significantly higher than that in control group. Dog bites and sites were risk factors, which informed us to consider *Bartonella* infection in the differential diagnosis for patients exposed to dog bites and specific medical examination should be performed.

**Authors' contributions**

Jimin Sun designed the study and drafted the manuscript. Guiming Fu carried out the blood sample collected. Junfen Lin performed analysis and interpret of data. Xiuping Song carride out serological testing. Liang Lu participated in the design of the study and helped to draft the manuscript. Qiyong Liu conceived of the study and participated in the design and coordination.

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References


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## Tables

### Table 1 Site locations and seroprevalence

<table>
<thead>
<tr>
<th>Site</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Positive number</th>
<th>Positive rate(%)</th>
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<tr>
<td>Hangzhou</td>
<td>30.15°N</td>
<td>120.20°E</td>
<td>59</td>
<td>46</td>
<td>105</td>
<td>34</td>
<td>32.38</td>
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<tr>
<td>Tiantai</td>
<td>29.14°N</td>
<td>121.03°E</td>
<td>51</td>
<td>53</td>
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<td>25.96</td>
</tr>
<tr>
<td>Longyou</td>
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<td>119.19°E</td>
<td>30</td>
<td>20</td>
<td>50</td>
<td>11</td>
<td>22.00</td>
</tr>
<tr>
<td>Huzhou</td>
<td>20.52°N</td>
<td>120.04°E</td>
<td>34</td>
<td>18</td>
<td>52</td>
<td>8</td>
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<tr>
<td>Jiangshan</td>
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<td>118.61°E</td>
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<td>20</td>
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<tr>
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<td>14</td>
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<tr>
<td>Longquan</td>
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<td>119.12°E</td>
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<td>21</td>
<td>52</td>
<td>8</td>
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<td>Linhai</td>
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<td>121.12°E</td>
<td>35</td>
<td>21</td>
<td>56</td>
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<tr>
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<td>317</td>
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<td>556</td>
<td>109</td>
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