Prospective Study of Enteric Campylobacter Infections in Children from Birth to 6 Months in the Central African Republic

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A survey of enteric Campylobacter infections was performed in Bangui, Central African Republic, with a cohort of 127 children from birth to 6 months of age by biweekly culture of stools; 82 infections were observed, and 41.7% of the children presented at least 1 infection before 6 months of age. Only 15.9% of the infected children had a diarrheic syndrome; moreover, 61.5% of these diarrheic children had another enteropathogen associated with Campylobacter species. In about half the cases, Campylobacter spp. were excreted for more than 4 days. More than half of the children had at least one diarrheic episode, for which an enteropathogen was identified in one third of the cases, before 6 months of age.

Since the establishment of simple techniques for the isolation of Campylobacter species from stools, numerous studies have been done in different countries for a better understanding of the role of the etiology in the organism of human diarrhea. It is more prevalent in diarrheic stools in developing countries (1, 3, 5, 7, 10, 13, 15) than in developed countries (4, 19). However, the real role of the bacterium is poorly appreciated; several researchers (in Bangladesh and South Africa) have shown the existence of a large number of healthy carriers (3, 5, 10, 13). In Bangui, Central African Republic, an etiologic study of infantile diarrhea performed from 1981 to 1982 showed Campylobacter species to be frequently identified in the stools of both diarrheic and nondiarrheic children, with no significant difference between the two groups (9). Here, we present the results of the surveillance of enteric Campylobacter infections from birth to 6 months of age in a cohort of selected infants who were born in a maternity ward in the city of Bangui; the purpose of the study was to define the factors that might explain the existence of a large number of healthy carriers of enteric Campylobacter species in the Central African Republic.

MATERIALS AND METHODS
A cohort of 127 children born in Maternite des Castors, a maternity ward of the city of Bangui, and whose parents lived in the immediate neighborhood was selected from October 1983 to June 1985. All the children were monitored until the age of 6 months by a nurse visiting them at home twice a week. For each child, we performed twice-weekly stool cultures for Campylobacter species; in the same period, for each diarrheic episode one complete investigation of the stools was done. Diarrhea was defined as an increase in the number of stools with at least three stools per day taking the form of the container. No transport medium was used, because stools were collected by a nurse at the home of the child and transported to the laboratory within 2 h.

The investigation for Campylobacter species was made by plating the stools on sheep blood Columbia agar (Oxoid Ltd., Basingstoke, United Kingdom) supplemented with Butzler antibiotic supplement (Virion Ltd., Cham, Switzerland). The plates were incubated at 42°C in a candle jar for 48 h. The identification of the bacterium was based on growth at 42°C in a candle jar on a selective medium, colony morphology, bacterial morphology after Gram stain, motility in dark-field illumination, and oxidase and catalase production (11).

All diarrheic stools were investigated for parasitic and bacterial enteropathogens and rotavirus. Parasitological investigations were made by direct examination with a light microscope of saline and iodine preparations and Mif and Kato concentration techniques (18, 20). Salmonella spp., Shigella spp., enteropathogenic Escherichia coli, Yersinia spp., and Vibrio spp. were detected by standard methods (8). The investigation for enterotoxigenic E. coli was done by enzyme-linked immunosorbent assay, the Biken test was used to detect heat-labile toxin, and transparietal inoculation of infant mice was used to detect heat-stable toxin (6, 12, 21). Rotavirus antigens were detected by enzyme-linked immunosorbent assay with the reagents and the technique of the World Health Organization Collaborating Center for Rotavirus (T. H. Flewett, Birmingham, United Kingdom) (22). Positive samples were confirmed by a blocking test with the reagents of the same center.

RESULTS
The cohort of 127 children included 46 girls and 81 boys. We observed 82 enteric Campylobacter infections, 33 in girls and 49 in boys. The ages of children with these infections are shown in Table 1: only 13 (15.9%) of the infected children presented with a diarrheal syndrome. In 8 of the 13 symptomatic infections, another enteropathogen was associated with Campylobacter species: in 3 cases it was rotavirus, in 2 cases it was enteropathogenic E. coli, in 1 case it was Salmonella spp., and in 2 cases it was rotavirus plus enteropathogenic E. coli. Of the 127-child cohort, 53 children (41.7%; 43.5% of girls and 40.7% of boys) exhibited at least one Campylobacter infection before the age of 6 months. The isolation rates of enteric Campylobacter species from diarrheic and nondiarrheic stools in the different age groups were compared.

<p>| Table 1. Ages of children and clinical distribution of enteric Campylobacter infection* |
|-------------------------------------|----------|-----------------|</p>
<table>
<thead>
<tr>
<th>Age (mo)</th>
<th>No. of infestations</th>
<th>Annualized incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1</td>
<td>11</td>
<td>132</td>
</tr>
<tr>
<td>2–3</td>
<td>14</td>
<td>84</td>
</tr>
<tr>
<td>4–6</td>
<td>57</td>
<td>228</td>
</tr>
</tbody>
</table>

* A total of 127 children were studied.
ENTERIC CAMPYLOBACTER INFECTIONS IN INFANTS

TABLE 2. Rate of isolation of enteric Campylobacter species from diarrheic and control routinely cultured children

<table>
<thead>
<tr>
<th>Age (mo)</th>
<th>Diarrheic stools</th>
<th>Routinely cultured stools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total no.</td>
<td>No. positive (%)</td>
</tr>
<tr>
<td>0-1</td>
<td>19</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>2-3a</td>
<td>118</td>
<td>10 (8.5)</td>
</tr>
<tr>
<td>3-6a</td>
<td>138</td>
<td>21 (15.2)</td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td>31 (11.3)</td>
</tr>
</tbody>
</table>

a Chi-square analysis: \( P < 0.001 \).

are shown in Table 2. Except in the 0- to 1-month age group, in which the bacterium was isolated only from nondiarrheic children, the isolation rate was significantly higher in the diarrheic stools than in the nondiarrheic stools. A total of 21 children presented more than one infection before the age of 6 months: 1 child exhibited four different infections, 6 children exhibited three different infections, and 14 children exhibited two different infections. The clinical aspect of these successive infections is quite unpredictable: 15 children presented a first and second asymptomatic infection, 4 children had a first infection that was symptomatic and a second one that was asymptomatic, and 2 children had a first infection that was symptomatic, with the second infection being symptomatic for 1 child and asymptomatic for the other child. In 39 of the infections (46.4% asymptomatic and 53.8% diarrheic), enteric Campylobacter species were identified in the stools of the same children several successive times. The duration of the different infections is shown in Fig. 1. There was no difference between diarrheic and healthy children in the median duration of prolonged elimination of the germ: between 7 and 8 days for the two groups. In 24 cases, the serotype of the successive Campylobacter isolates was determined by the hemagglutination technique.

FIG. 1. Duration of Campylobacter infections. All infections of fewer than 4 days' duration are shown in column 1.
of Penner et al. (16) and the slide agglutination test of Lior et al. (14). In nine cases, two different serotypes were successively identified. The isolation rates of Campylobacter species according to the type of feeding of the children are shown in Table 3. All children were either breast fed or breast and bottle fed. The rate of infections (whether they were symptomatic or not) was higher in children who were exclusively breast fed than in the others. The same observation is made if we consider only symptomatic infections, except in the 0- to 1-month group, in which all the children were asymptomatic. In the family of each child, the number of children under 12 years old was known; the median of the number of children under 12 years old present at home was the same for the group of children who had at least one Campylobacter infection as for the group who never did, i.e., between three and four children. We observed 103 diarrheic episodes among the 127 children; 60 children never exhibited diarrhea, 40 children had one case of diarrhea, 20 children had two diarrheal episodes, 5 children had three diarrheal episodes, and 2 children had four episodes. An enteropathogen was identified in 32 cases (31%). The results of stool examinations for diarrheic children are shown in Table 4. Nine children had two or more enteric pathogens. The youngest child to present a case of diarrhea was 11 days old. In 37.8% of the observed cases of diarrhea, the children were breast fed; in the other cases, they were breast and bottle fed. Diarrheic children were treated by oral rehydration when they presented dehydration signs. Only two children presented severe dehydration, and they were rehydrated by intravenous fluids; they were both infected by rotavirus. The diarrheic children infected by Campylobacter species received antibiotic treatment by oral administration of erythromycin (40 mg/kg [body weight] daily).

**DISCUSSION**

Campylobacter species are frequently isolated from the stools of infants in the Central African Republic; in this study, 41.7% of a cohort of 127 children presented at least one infection before 6 months of age. The infection can occur very early in life: 4 children were infected by their third day, and 11 were infected before the age of 1 month. It should be emphasized that all the infections observed before the age of 1 month were asymptomatic. The number of observed infections was significantly higher between 3 and 6 months of age than in the 4- to 6-month age group (chi-square analysis; \( P < 0.01 \)).

The presence of Campylobacter species in the stools was accompanied by diarrhea in only 15.9% of the cases; in 61.5% of them, another enteropathogen was associated with campylobacters. However, if the isolation rates of enteric Campylobacter species from diarrheic and nondiarrheic children are compared, the rate was significantly higher in the diarrheic group. The carriage of enteric Campylobacter species is rare or nonexistent in developed countries, where its prevalence is low (2, 19). In developing countries, on the other hand, where the prevalence of the bacterium is higher, different researchers have emphasized the high rate of carriage, mainly in South Africa and Bangladesh (3, 5, 10, 13). All the children of the cohort were either breast or breast and bottle fed; a protective role for maternal milk antibodies can be imagined, but further studies are needed in that area. A comparative study in Bangladesh of the prevalence of Campylobacter infections in breast-fed and non-breast-fed children under 8 months old showed no protective effect of breast feeding (17). The early age and frequency of contact of children with Campylobacter species perhaps explain the large number of healthy carriers that we observed among the children between the ages of 6 and 24 months in a previous etiologic investigation (9).

In about half the infections, we observed prolonged elimination of Campylobacter species; this was noted in diarrheic as well as healthy children. There does not seem to be any relation between the duration of elimination and the asymptomatic or asymptomatic aspect of the infection.

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**LITERATURE CITED**


