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Incidence of campylobacter infection in infants in western Algeria and the possible protective role of breast feeding

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SUMMARY

A case-control study aimed at comparing the incidence of campylobacter infection with that of other enteropathogens in infants was performed in Oran, Western Algeria. During a one-year period, infants consulting in a health centre were included if they had acute diarrhoea. The controls comprised infants going to the same centre for vaccination. Butzler medium Virion was used to look for thermophilic campylobacters. Campylobacters were isolated in 17·7% of the 411 patients and in 14·9% of the 247 controls. No statistically significant difference was found after stratification by age. In contrast, other enteropathogenic bacteria were rarely present. Among the potential factors of clinical expression of infection, breast feeding appeared to have a protective effect which was higher for campylobacter diarrhoea than that observed for other causes of diarrhoea. These data contrast with those previously published in Bangladesh and could be an incentive for promoting breast feeding in this country, where the tradition is decreasing far below the standard which is generally accepted.

INTRODUCTION

Campylobacter infection has been recognized as a worldwide cause of diarrhoeal infections since its identification by Butzler [1] and Skirrow [2]. Different epidemiological patterns of transmission have been described for developed and developing countries. In the latter, a high incidence of campylobacter-associated diarrhoea has been found, but asymptomatic infection is also common [3–5]. Algeria is a developing country with an advanced economy and a climate intermediate between the European countries in the north and sub-saharan Africa. It is interesting to know which epidemiological model applies to such an environment. A high prevalence is suggested by the high incidence of campylobacter infection in children of Algerian origin, now living in Europe, returning after vacation in their mother country.

Our goal was to compare the incidence of campylobacter infection with that of

other classical enteropathogens in infants attending a health centre in Oran, Algeria, and to evaluate the potential risk factors involved in the expression of symptoms in a case-control study.

PATIENTS AND METHODS

Patients

During a one-year period, children consulting during daytime hours at the Health Centre Ibn Sina in a suburb of Oran, Algeria, were included in the study if they were less than one year old and had acute diarrhoea according to the WHO case definition [6].

Faecal specimens were obtained by swabbing the rectum four times. Swabs were introduced in a transport medium (Cary Blair), maintained at 4 °C and processed within 5 h after collection.

Controls

A control group, comprising infants attending the same health centre during the same period for vaccination, was studied in parallel and in the same manner. They were excluded if they had had diarrhoea in the previous 2 weeks. The faeces were processed in the same manner as for the patients.

Microbiological analysis

Faecal suspensions were made in saline and inoculated on bromocresol purple medium and Hektoen medium for *Shigella* species. For *Salmonella* species, an enrichment culture was performed in selenite medium with subculture after 24 h to Salmonella–Shigella medium. All media were from bioMérieux (Marcy l'Etoile, France). Thermophilic campylobacters were sought on Butzler medium Virion [7] incubated for 2 days at 42 °C in a microaerobic atmosphere (Don Whitley jar with H_2+CO_2 gas generating kit without catalyst). Conventional identification techniques were used. The hippurate hydrolysis test was employed to differentiate *Campylobacter jejuni* (positive) from *C. coli*.

All the specimens were submitted to the same protocol.

Statistical analysis

The odds ratios (ORs), with their 95% confidence interval (CI) computed by the method of Miettinen, was used to estimate the strength of the associations. The Mantel-Haenszel chi-square test was used to compare the two groups.

RESULTS

There was no statistically significant difference between the 411 patients and 247 controls included during the study period with regard to sex distribution (48·8% and 50·6% were male, respectively), age distribution (patients, mean $\pm$ S.D. = 6·2 $\pm$ 3·0 months; controls, 5·8 $\pm$ 2·7) or seasonal distribution. Besides diarrhoea, the main symptoms observed in the cases were the following: abdominal pain (47%), fever (38%), vomiting (34%) and mild dehydration (3%). Seventy per cent of these patients had not had another diarrhoeal episode in the

Table 1. *Comparative results of the isolation of* Campylobacter *species in stool specimens according to age in patients and controls in Oran, Algeria*

Age (months)	Patients: No. positive/ No. tested	Patients: Positive (%)	Controls: No. positive/ No. tested	Controls: Positive (%)	*P*
0–3	15/89	16·8	8/51	15·6	0·9
4–6	24/131	18·3	18/110	16·3	0·8
7–9	24/129	18·6	11/73	15·0	0·1
10–12	10/62	16·1	0/13	0	0·1
Total	73/411	17·7	37/247	14·9	0·4

Table 2. *Clinical presentation of the patients according to the presence or absence of* Campylobacter *species in the stool specimens*

	Campylobacter present (%)	Campylobacter absent (%)
Number of stools per day (mean + S.D.)	4·7 + 1·8	4·7 + 1·8
Watery diarrhoea	57·1	58·5
Vomiting	31·1	35·5
Abdominal pain	42·8	48·4
Mild dehydration	3·9	3·0
Fever	38·1	38·2

Table 3. *Comparison of campylobacter isolation in stool specimens according to the season in patients and controls in Oran, Algeria*

Months	Patients: No. positive/ No. tested	Patients: Positive (%)	Controls: No. positive/ No. tested	Controls: Positive (%)	*P*
January–March	2/30	6·6	1/33	3·0	0·9
April–June	28/125	22·4	7/52	13·4	0·8
July–September	39/180	21·6	23/137	18·2	0·5
October–December	8/76	10·5	4/25	16·0	0·7
Total	77/411	18·7	35/247	14·1	0·2

preceding month. Antidiarrhoeal treatment prior to the consultation was mentioned in 42% of the cases, but antibiotics comprised only 3·6% of the drugs administered. A concomitant infection was present in 40% of the patients, in particular, upper respiratory tract infections.

Seventy-seven isolates of campylobacter (17·7%) were found in patients and 37 (14·9%) in the control group of the same age. No statistically significant difference was found between the two groups after stratification by age (Mantel Haenszel test, $P = 0·4$) (Table 1). The other pathogens were seldom found: *Salmonella* spp. (two in the patient group and none in the control group); and *Shigella* spp. (none in the patient group and one in the control group). Fifty-five campylobacter strains were identified at the species level: 38 in the patient group and 17 in the control group. Five were *C. coli* (14·5%); the others were *C. jejuni*. The distribution of the two species was the same in each group.

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Table 4. *Comparison of the practice of exclusive breast feeding in campylobacter-positive infants between birth and 6 months of age in Oran, Algeria*

	Diarrhoea	No diarrhoea	Total
Exclusively breast fed	4	10	14
Not exclusively breast fed	31	13	44
Total	35	23	58

Protection from diarrhoea by exclusive breast feeding: OR 0·1 (95% CI, 0·04–0·74); $P < 0·02$.

The clinical presentation was identical in the campylobacter-positive and -negative groups of patients (Table 2).

No difference was observed concerning the rate of isolation of campylobacter after stratification by season (Table 3). Isolation rates were highest in the summer.

Among the campylobacter-infected infants, we studied potential factors of clinical expression of infection by comparing those with diarrhoea and those without. There was no statistically significant difference for the mean age (patients, $6·07 \pm 2·89$ months; controls, $5·48 \pm 2·34$ months) or the weight-for-age ratio (patients, $7·87 \pm 7·07$; controls, $4·5 \pm 4·8$) between groups. However, a difference was found in relation to breast feeding, which was protective (OR: 0·3, CI: 0·1–0·9). In addition, because in this study only infants less than 6 months old were breast fed, this difference was even greater when the infants less than 6 months old were considered by themselves (Table 4). The protective effect was found to a lesser extent when campylobacter-negative infants (with and without diarrhoea) were considered; the OR was only 0·6, CI 0·3–1·2.

DISCUSSION

Until now, no community studies on campylobacter infection have been performed in North Africa. None the less, campylobacter-associated diarrhoea is especially common among North African children living in Europe who return from vacation in their country of origin. We performed this study in a health centre serving the needs of a suburban community which can be considered to be representative of cities in Algeria. This was a case-control study, with controls recruited from the same health centre. They can be considered as reasonably representative of the infants of the community, since 80% of them go to the centre to be vaccinated and very few private practitioners work in this area.

One of the unexpected findings of this study was the low incidence of salmonella infection. Previous studies showed that salmonella was a major enteropathogen in the Maghreb [8]. In fact, those studies were performed on patients in hospital settings and not on ambulatory patients as in this study. Our technique was reviewed, and in the same period we obtained isolates from in-patients. These data suggest that *Salmonella* species are not common in the community but that they are important nosocomial pathogens. A low incidence of salmonella was also found in a community study in Pakistan [9].

Campylobacter isolation rates in children with and without diarrhoea were not significantly different (Table 1). This epidemiological pattern of campylobacter infection is closer to that described in developing countries than in developed ones.

As in other studies [10], the determination of pathogenic properties of the strains from this study failed to show a difference between strains from patients and controls [11]. The high summer incidence of infection is like that of countries with temperate climates.

The low incidence of *C. coli* (14·5%) was similar to that observed in children in France (16·7%) [12], despite the fact that an important source of *C. coli* is pork meat, which does not exist in a strict Muslim country like Algeria.

It has been shown that children from developing countries have higher blood campylobacter antibody levels than children from developed countries [13], which could be the reason for the protection from the clinical expression of the infection. In infants less than 6 months old antibody production is still low, but we found that exclusive breast feeding protected infants significantly from the disease (OR: 0·1). Protection was less important (OR: 0·6) for the other diarrhoeal cases. However, these conclusions must be interpreted cautiously. In a critical analysis of breast feeding in developed countries, Bouchner and colleagues found many biases which could alter the final results [14]: for example, detection biases such as the difficulty in identifying diarrhoea during the first months of life in the breast-fed group, and confounding variables such as socioeconomic standards. Our study may suffer from these problems, since it was not designed specially for this purpose. Our results are contrary to those of another study carried out in Bangladesh according to a different design [15]. That study concluded that a transplacental immunity and not breast milk could be the reason for the protection. Recently, a Brazilian group presented data supporting the hypothesis that breast feeding was protecting infants mainly from death due to infections. The highest relative risk of death was obtained for diarrhoea in completely weaned infants [16]. In Algeria, as in some other developing countries, the tradition of breast feeding is decreasing far below the standards which are generally accepted. This is a potential source of problems for these countries with low income. It is, therefore, important to have arguments to promote the importance of breast feeding. A study specially designed to investigate the protective role of breast feeding on *C. jejuni* infection and which includes biological studies of mother's milk should be performed to answer this important question.

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REFERENCES

1. Butzler JP, Dekeyser P, Detrain M, Dehaen F. Related vibrio in stools. J Pediatr 1973; **82**: 493–5.
2. Skirrow MB. Campylobacter enteritis: a 'new' disease. Br J Med 1977; **2**: 9–11.
3. Blaser MJ, Glass RI, Huq MI, Stoll B, Kibriya GM, Alim AR. Isolation of *Campylobacter fetus* subspecies *jejuni* from Bangladeshi children. J Clin Microbiol 1980; **12**: 744–7.

4. Rajan DP, Mathan VI. Prevalence of *Campylobacter fetus* subsp. *jejuni* in healthy populations in southern India. J Clin Microbiol 1982; **15**: 749–51.
5. Taylor DN, Blaser MJ, Echeverria P, Pitaragansi C, Bodhidatta L, Wang WL. Erythromycin-resistant campylobacter infections in Thailand. Antimicrob Agents Chemother 1987; **31**: 438–42.
6. Treatment and prevention of acute diarrhea. Guidelines for the trainers of health workers. WHO, Geneva 1985 (unpublished document).
7. Goossens H, De Boeck M, Butzler JP. A new selective medium for the isolation of *Campylobacter jejuni* from human faeces. Eur J Clin Microbiol 1983; **2**: 389–94.
8. Ayache R, Kheder M, Abroug M et al. Salmonella infection in a pediatric department. Méd Mal Infect 1989; **19**: 391–2.
9. Kazmi RR, Hafeez A, Kazmi SU. Polymicrobial infection in *Campylobacter jejuni* enteritis in Karachi. FEMS Microbiol Lett 1987; **41**: 153–6.
10. Mathan VI, Rajan DP, Klipstein FA, Engert RF. Enterotoxigenic *Campylobacter jejuni* among children in South India. Lancet 1984; ii: 981.
11. Belbouri A, Mégraud F. Enterotoxin-like activity produced by *Campylobacter jejuni* and *Campylobacter coli* isolated from patients and healthy controls in Algeria. FEMS Microbiol Lett 1988; **51**: 25–8.
12. Mégraud F, Gavinet AM. L'infection à Campylobacter de l'enfant hospitalisé. Ann Pédiatr 1989; **36**: 970–1000.
13. Blaser MJ, Black RE, Duncan DJ, Amer J. *Campylobacter jejuni*-specific serum antibodies are elevated in healthy Bangladeshi children. J Clin Microbiol 1985; **21**: 164–7.
14. Bouchner H, Leventhal JM, Shapiro ED. Studies of breast-feeding and infections. How good is the evidence? JAMA 1986; **256**: 887–92.
15. Glass RI, Stoll BJ, Blaser MJ, Khan MR, Hossain KMB. Effect of breast-feeding on protection against diarrhea associated with *Campylobacter jejuni*. In: Pearson AD, Skirrow MB, Lior H, Rowe B, eds. Campylobacter III. London: Public Health Laboratory Service, 1985: 130.
16. Victoria CG, Smith PG, Vaughan JP et al. Evidence for protection by breast-feeding against infant deaths from infectious diseases in Brazil. Lancet 1987; ii: 319–28.