Survey on the Incidence of Yersinia enterocolitica Infection in Canada

S. TOMA AND LUCETTE LAFLEUR

Ministry of Health, Laboratory Services Branch, Toronto, Ontario, MSW 1R5, and St. Justin Hospital, Montreal, Quebec, Canada

Received for publication 11 June 1974

Data pertaining to 278 cultures of Yersinia enterocolitica isolated in Canada are summarized in this paper. Of this amount, 256 were isolated from humans, whereas 22 were of nonhuman sources. The typing of these cultures is presented together with their geographical location. Y. enterocolitica serotype O:3 biotype 4, phage type 9b, was practically the only serotype present in the Province of Quebec. This serotype O:3 was also predominant in Ontario, followed by serotypes O:5, 27 and O:6, 30; other serotypes were seldom isolated. In the central and western areas of Canada, Y. enterocolitica was occasionally isolated; the strains were indole-positive, serotypes O:5, 27, O:8, and O:4, 32.

The number of Yersinia enterocolitica infections diagnosed in humans has increased considerably during the last decade. In 1966 there were only 23 recorded cases of Y. enterocolitica infection. Mollaret reported 642 cases in 1970 and more than 1,000 in 1972 (9). This number has now exceeded 4,000 cases. There has been a steady increase in the recorded incidence of infection and in the number of countries which report Y. enterocolitica isolations. The clinical aspects of the disease have widened, and the various animal species in which this bacterium is found have increased.

Acute gastroenteritis is the most frequent clinical form of this infection, followed by an acute right iliac fossa syndrome (pseudapendicitis, mesenteric lymphadenitis, or terminal ileitis). The incidence of Y. enterocolitica, isolated from feces specimens in cases of acute bacterial gastroenteritis is reported by some specialists to have surpassed the incidence of Shigella, being second to Salmonella. Other clinical conditions described are septicemia, polyarthritis, erythema nodosum, and abscesses.

During 1966–1970 most of the Y. enterocolitica infections were reported from northwestern European countries (2, 11, 18), Canada (6), and the United States (13). Later, infections were reported from central and eastern Europe, some countries in Africa, and Japan.

The predominant human serotype of Y. enterocolitica in Europe, Africa, Japan, and Canada is the indole-negative, biotype 4, serotype O:3. Strains of serotype O:3 isolated in Europe and Japan belong to phage type 8, those from South Africa to either phage type 8 or 9a, and those from Canada to the "specific Canadian" type, 9b (10). Y. enterocolitica serotype O:9 is the second most common human serotype in Europe and Africa and has been reported in Japan. In the United States different serotypes of Y. enterocolitica were isolated from a variety of clinical syndromes, but there were only a few isolates from cases of acute gastroenteritis. The most predominant type was the indole-positive serotype O:8. Occasionally, other serotypes were isolated: 3; 5, 27; 15; 16; 8, 19; 11, 24; 18; 20; 21(20, 21, T. J. Quan, Plague Section C.D.C., Fort Collins, Colo.; list of Y. enterocolitica culture collection [personal communication].

Human cases of gastroenteritis due to Y. enterocolitica, reported until 1972, have been either sporadic or confined to small family outbreaks. During the past two years outbreaks have been described in Japan (3, 23), Finland (15), and the United States (5).

Until recently, Y. enterocolitica was isolated from humans or different animal species only. Lately, Y. enterocolitica was isolated from water specimens by Lassen (8), Wauters (19), and Toma (16). The present paper reports data on Y. enterocolitica isolated from human and nonhuman sources.

METHODS

Appropriate references to methods used are given in the Results section.

RESULTS

Human infection with Y. enterocolitica. Lafleur et al. were the first to present detailed biological, clinical, and epidemiological information about this infection in Canada; 102
cases of gastroenteritis were studied in St. Justin Hospital, Montreal, Que., between 1966–1972 (4, 6). Schieven reported the first Y. enterocolitica isolations in Ontario (personal communication, 1971; 12). Toma reported 59 cultures of Y. enterocolitica isolated from human and nonhuman sources by different laboratories throughout Ontario (16, 17). Data on other Y. enterocolitica cases were published from Montreal, Que. (1), and Vernon, B.C. (14).

In this paper data pertaining to 256 Y. enterocolitica cultures isolated from humans in Canada are summarized on the basis of source of isolation, bio- and sero-phage typing, and geographical distribution (Table 1). Most of these cultures were biotyped and serotyped in the Yersinia Reference Centre of the Ontario Provincial Public Health Laboratory, Toronto. The methods used for isolation of Y. enterocolitica from feces, and for identification, were described by Wauters (18), Nilehn (11), and in our previous papers (4, 6, 16). From a total of 256 cultures, 244 were isolated from feces specimens of cases of acute gastroenteritis. Most of these were isolated from children in the lower age group. Six cultures were isolated from blood specimens from elderly debilitated people, three from mesenteric lymph nodes, and three from pus.

Only one culture of Y. enterocolitica was isolated from the eastern area of Canada (E. V. Haldane, Halifax, Nova Scotia, personal communication). The great majority of cultures were isolated from the Province of Quebec (153 cultures) and Ontario (88 cultures). All but one culture isolated from Montreal and other areas of the Province of Quebec were indole-negative serotype O:3, the most predominant serotype in Europe, Africa, and Japan. Y. enterocolitica serotype O:3 was also predominant in Ontario (73%), followed by the serotypes O:5,27 (13%) and O:6,30 (7%), and occasionally other serotypes were isolated (Table 1). Four Y. enterocolitica cultures could not be serotyped with the 34 “O” antisera presently available. In the central and western part of Canada the picture was different. All Y. enterocolitica isolated were indole positive; one culture serotype O:8, was found in Saskatchewan (H. Robertson, personal communication), the serotype O:5,27 was predominant in Alberta (J. M. S. Dixon and Y. Goodman, personal communication), and the serotypes O:8, O:4,32; and O:5,27 were found in British Columbia (W. H. Cockroft, personal communication; 14).

All but four of the Y. enterocolitica cultures, serotype O:3, isolated in Canada belonged to the specific “Canadian” phage type 9b. Four serotype O:3 cultures were phage type 8; two of the respective patients had arrived from Europe, where they probably acquired the infection, and one culture was isolated from a 2-month-old baby of unknown background. The indole-positive Y. enterocolitica cultures were phage typed as 10 (10; 10; 10)z. All the cultures were phage typed in the Yersinia Reference Centre, Institut Pasteur, Paris (H. H. Mollaret and P. Nicolle, personal communication).

Nonhuman isolations of Y. enterocolitica. Twenty-two Y. enterocolitica cultures were isolated from animals, birds, oysters, and water specimens in Ontario, Alberta, and British Columbia (Table 2). Some of these cultures were described previously (16). One culture, isolated from a cat, was serotype O:3, phage type 9b. The others were indole-positive cultures: serotype O:5,27 (six cultures), O:6,30 (three cultures), or other different serotypes. Three cultures were not typable. Besides the cultures presented in Table 2, Langford reported 23 infections with Y. enterocolitica in mammals and birds in the Fraser Valley area of British Columbia: 18 chinchillas, two pigeons, one ocelot, one mink, and one sheep (7). Unfortunately, the strains reported were not typified and have been lost.

Susceptibility of Y. enterocolitica cultures to antibacterial drugs. The cultures were susceptible to tetracycline (except two cultures), streptomycin, polymyxin, gentamicin, chloramphenicol, nitrofurantoin, and sulfonamide (except a few cultures). Some of the cultures, recently tested, were sensitive to trimethoprim-sulfamethoxazole.

The cultures were resistant to penicillin, oxacillin, lincomycin, and novobiocin and varied in their resistance to ampicillin, cephalothin, and carbenicillin.

Seventeen indole-positive Y. enterocolitica cultures were found to be susceptible to ampicillin. It is important to mention that all our Y. enterocolitica serotype O:8 cultures (either isolated in Canada or the stock cultures) were ampicillin sensitive. None of the indole-negative serotype O:3 strains were susceptible to ampicillin.

DISCUSSION

Human infections due to Y. enterocolitica have now been reported in numerous countries all over the world. There has been a steady increase in the recorded incidence of infection and in the number of countries which report this infection. In spite of these facts, knowledge of the geographical distribution of this organism is still fragmentary. For instance, most of the
| Province         | No. of cultures | Specimens | Serotype “O” |
|------------------|-----------------|-----------|--------------|
|                  |                 | Feces     | Mesenteric lymph nodes | Blood | Pus | 3 | 5.27 | 6.30 | 8 | 4.32 | 5 | 12.25 | 20 | 34 | Not typable |
| Nova Scotia      | 1               | 1         |                | 1      |     |   | 1    |     |    |      |    |       |    |    |             |
| Quebec           | 153             | 152       | 1              |        | 152 |   |      |     |    |      |    |       |    |    | 1           |
| Ontario          | 88              | 84        | 3              | 1      | 64  | 11| 6   |    |    | 1    | 1  |       |    |    | 1           |
| Saskatchewan     | 1               | 1         |                |        |     |   | 1    |     |    |      |    |       |    |    | 1           |
| Alberta          | 7               | 7         |                |        |     |   | 6    | 1   |    |      |    |       |    |    |             |
| British Columbia | 6               | 1         | 3              | 1      | 1   | 1 | 3  | 2   |    |    |      |    |       |    |    |             |
| Total            | 256             | 244       | 3              | 6      | 3   | 217| 18 | 6   | 5  | 2   | 1  | 1    | 1  | 1  | 4           |
| Province | Specimens | Source | Feces | Autopsy | No. | Serotype “O” | Remarks |
|----------|-----------|--------|-------|---------|-----|--------------|---------|
|          |           |        |       |         |     | 3 | 4.32 | 4.33 | 5 | 5.27 | 6.30 | 7.13 | 14 | 16 | 17 | Not typable |
| Ontario  | Cat       | 1      | 1     | 1       |     | 1 |     |     | 1 |     |     |     |     |     |     |     | "Canadian" phage type 9b |
|          | Dog       | 1      | 1     |         |     |   |     |     |   |     |     |     |     |     |     |     | Rhamnose positive |
|          | Beaver    | 1      | 1     |         |     |   |     |     |   |     |     |     |     |     |     |     | Indole negative |
|          | Canada    | 1      |       |         |     |   |     |     |   |     |     |     |     |     |     |     | |
|          | goose     | 1      |       |         |     |   |     |     |   |     |     |     |     |     |     |     | |
|          | Camel     | 1      | 1     |         |     |   |     |     | 1 |     |     |     |     |     |     |     | Many atypical biochemical features |
|          | Raccoon   | 1      | 1     |         |     |   |     |     |   |     |     |     |     |     |     |     | |
|          | Pekin robin | 1 | 1 |       | | | | | | | | | | | | |
|          | Oysters Water specimens | 4 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 3 | | | | | | |
| Alberta  | Chinchilla | 1 | 1 | | | | | | | | | | | | | Knox 1017/60-61; from a chinchilla dying enroute to Denmark from Canada. I.P. 96 |
| British Columbia | Chinchilla | 2 | 2 | | | | | | | | | | | | | |
| Unknown  | Chinchilla | 1 | 1 | | | | | | | | | | | | | |
| Total    |           |     | 22    | 1       | 2 | 1 | 1 | 6 | 3 | 1 | 1 | 1 | 1 | 1 | 4 | |
western and northwestern European countries reported hundreds of Y. enterocolitica isolations, whereas only one culture was recorded in the United Kingdom. Y. enterocolitica serotype O:3 is predominant in Europe, Africa, and Japan. In Canada, 278 cultures were isolated, most of them from feces specimens of cases of acute gastroenteritis, and the serotype O:3 was the predominant type. In the United States, Y. enterocolitica strains were isolated from a wide variety of clinical specimens, other than feces. The predominant serotype was O:8, and the serotype O:3 has seldom been reported. Serotype O:9, the second most predominant human serotype in Europe and Africa, and reported from Japan, has not yet been reported in North America. The serotype O:8, predominant in the United States and isolated in the western areas of Canada, has never been isolated in Europe. The same geographical differences are encountered within the phage pattern of Y. enterocolitica serotype O:3, i.e., the phage type 8 is present in Europe and Japan, the phage type 8 or 9a and 9b in Canada.

Some of the Y. enterocolitica cultures isolated from water specimens, or occasionally from human or animal sources, are biochemically and serologically atypical. It would appear that there are Yersinia-like organisms which have to be differentiated from Y. enterocolitica (22).

There are many laboratories which have not isolated Y. enterocolitica from feces specimens. Failure to isolate this organism from these specimens is probably related to lack of experience and proper techniques, rather than to the absence of Y. enterocolitica in this particular area. Our own personal experience, as well as the experience of different laboratories in many other countries, has confirmed this belief.

Further investigations are necessary to establish the real incidence of Y. enterocolitica in human and nonhuman sources. There is need also for improvement of the laboratory methods for the isolation and identification of Yersinia. Further investigations are also necessary to clarify the taxonomy of this group, to define Y. enterocolitica and the Y. enterocolitica-like organisms, and to determine the etiology, pathogenicity, and epidemiology of Y. enterocolitica in various types of infections.

ACKNOWLEDGMENTS

We are grateful to H. H. Mollaret, G. Wauters, and S. Winblad for kindly supplying us with stock cultures of Y. enterocolitica, conforming our atypical culture results, and for their continuous important advice and encouragement.

We are also grateful to A. W. Jackson, L.C.D.C., Ottawa, and to many physicians and laboratory workers throughout Canada who supplied us with cultures, sera, and the necessary data.

The competent assistance of R. Deidrick is gratefully acknowledged.

LITERATURE CITED

1. Abramovitch, H., and C. A. Butas. 1973. Septicemia due to Yersinia enterocolitica. Can. Med. Ass. J. 109:1112-1115.
2. Ahvonen, P. 1972. Human Yersiniosis in Finland. Ann. Clin. Res. 4:30-48.
3. Asakawa, Y., S. Akahane, N. Kagata, M. Masateru, R. Sakazaki, and K. Tamura. 1973. Two community outbreaks of human infection with Yersinia enterocolitica. J. Hyg. 71:715-723.
4. Delorme, J., M. Laverdiere, B. Martineau, and L. Lafleur. 1974. Yersiniosis in children. Can. Med. Ass. J. 110:281-284.
5. Gutman, L. T., E. A. Ottesen, T. J. Quan, P. S. Noce, and S. L. Katz. 1972. An inter-familial outbreak of Yersinia enterocolitica enteritis. N. Engl. J. Med. 288:1372-1377.
6. Lafleur, L., B. Martineau, and L. Chicoine. 1972. Yersinia enterocolitica. Union Med. Can. 101:2407-2413.
7. Langford, E. V. 1972. Yersinia enterocolitica isolated from animals in the Fraser Valley of British Columbia. Can. Vet. J. 13:109-113.
8. Lassen, J. 1972. Yersinia enterocolitica in drinking water. Scand. J. Infect. Dis. 4:125-127.
9. Mollaret, H. H. 1972. Un domaine pathologique nouveau: l'infection à Yersinia enterocolitica. Ann. Biol. Clin. 30:1-6.
10. Nicolle, P., H. Mollaret, and J. Brault. 1973. Recherches sur la lysogenie, la lysosensibilité, la lysotypie et la sérologie de Yersinia enterocolitica, p. 54-58. In Contributions to microbiology and immunology, vol. 2, Karger, Basel.
11. Nilehn, B. 1969. Studies on Yersinia enterocolitica with special reference to bacterial diagnosis and occurrence in human acute enteric disease. Acta Pathol. Microbiol. Scand. Suppl. 200:1-48.
12. Schieven, B. C., and C. Randall. 1974. Enteritis due to Yersinia enterocolitica. J. Pediat. 84:402-404.
13. Sonnenwirth, A. C., and R. E. Weaver. 1970. Yersinia enterocolitica. N. Engl. J. Med. 283:1468.
14. Spiller, G. W. 1973. Yersiniosis due to Yersinia enterocolitica. Brit. Columbia Med. J. 15:338 and 347.
15. Toivanen, P., A. Toivanen, L. Olkkonen, and S. Aantaas. 1973. Hospital outbreaks of Yersinia enterocolitica infection. Lancet 1:801-803.
16. Tomo, S. 1973. Survey on the incidence of Yersinia enterocolitica in the Province of Ontario. Can. J. Publ. Health 64:477-487.
17. Tomo, S., H. Lior, M. Quinn-Hill, N. Sher, and W. A. Walker. 1972. Yersinia enterocolitica infection: report of two cases. Can. J. Publ. Health 63:433-436.
18. Wauters, G. 1970. Contribution à l'étude de Yersinia enterocolitica. Vander, Louvain.
19. Wauters, G. 1972. Souches de Yersinia enterocolitica isolées de l'eau. Rev. Ferment. Ind. Aliment. 7:18.
20. Wauters, G., L. Le Minor, A. M. Chalon, and J. Lassen. 1972. Supplément au schéma antigénique de Yersinia enterocolitica. Ann. Inst. Pasteur (Paris) 122:951-956.
21. Weaver, R. E., and J. G. Jordan. 1973. Recent human isolates of Yersinia enterocolitica in the United States, p. 120-125. In Contributions to microbiology and immunology, vol. 2, Karger, Basel.
22. Winblad, S. 1973. Studies on the O-serotypes of Yersinia enterocolitica, p. 27-37. In Contributions to microbiology and immunology, vol. 2, Karger, Basel.
23. Zen-Yoji, H., T. Maruyama, S. Sakai, S. Kimura, T. Mizuno, and T. Momose. 1973. An outbreak of enteritis due to Yersinia enterocolitica occurring at a Junior High School. Jap. J. Microbiol. 17:220-222.