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Current Trends of *Yersinia enterocolitica* Isolates in the New York City Area

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During an 8.5-year period (1974 to 1982), 56 *Yersinia enterocolitica* isolates from patients residing mainly in the New York City area were studied. Evaluation of these isolates revealed a marked increase in bacteremic episodes caused by strains of serogroups of O:3 and O:5,27 and the overall emergence of serogroup O:3, biotype 4, phage type 9b *Y. enterocolitica*. Of the serogroup O:3 stool isolates, 59% (19/32) were recovered from patients in their first year of life. One of these subjects had concurrent serogroup O:3 bacteremia. The apparent establishment of serogroup O:3 *Y. enterocolitica* in urban communities raises the potential for widespread outbreaks of disease caused by these strains.

Since infection due to *Yersinia enterocolitica* in the United States was first described (1939) (25), it has been reported with increasing frequency, with single-case presentations of unusual infections, e.g., infection of a mycotic aneurysm (22) or interfamilial (15) or large-scale outbreaks (4) comprising the majority of published reports. Epidemiological surveys of human yersiniosis in the United States have appeared in 1973 (38) and 1979 (3).

The noteworthy feature in the majority of these reports has been the predominance of serogroup O:8 *Y. enterocolitica* as the major human pathogen in the United States and the sparsity of serogroup O:3 isolates, despite the fact that the latter serogroup accounts for nearly 80% of the isolates in other parts of the world and in Canada (36).

Because yersiniosis is not a reportable disease in the United States, changes in epidemiology relative to the emergence of a new serogroup may be slow to evolve unless isolates are forwarded to a reference or special-interest laboratory. Since 1974, this laboratory has served as an unofficial repository for *Y. enterocolitica* isolates referred mainly from hospitals within a 50-mile radius of New York City. Evaluation of these isolates has shown a dramatic shift toward the emergence of serogroup O:3, biotype 4, phage type 9b *Y. enterocolitica* in the New York City area and a marked increase of bacteremic episodes due to serogroup O:5,27 strains.

MATERIALS AND METHODS

In the 8.5-year period (1974 to 1982) of this survey, 56 *Y. enterocolitica* isolates were studied. Six were recovered from clinical sources at The Mount Sinai Hospital, and 50 were clinical isolates referred for confirmation (see Table 1). All stool isolates were community acquired, recovered by direct plating without cold enrichment, and characterized according to standard criteria (33) by conventional means and by a miniaturized test system (Analytab Products, Plainview, N.Y.). The Wauters (G. Wauters, Ph.D. thesis, Vander University, Louvain, Belgium, 1970) scheme was used for biotyping isolates. Serotyping and phage typing of isolates were performed through the courtesy of S. Toma, Ministry of Health, Ontario, Canada.

RESULTS AND DISCUSSION

Table 1 shows some of the information pertinent to the 56 *Y. enterocolitica* isolates studied. These strains were recovered from sites representative of the spectrum of infections caused by *Y. enterocolitica* (5). Of the 57 isolates, 32 (57%) were derived from stool cultures, 19 (59%) of which were grown from samples from patients during the first year of life. These findings confirm earlier reports of *Y. enterocolitica* gastrointestinal infection in infants in the United States (18, 24, 40).

The 14 blood isolates accounted for an astonishing 25.5% of all isolates. That these strains were obtained mainly from patients with various underlying disorders, e.g., hepatic cirrhosis, leukemia, organ transplantation, and cholecystitis, extends the finding of Mollaret (21), who, in 1971, reported 17 cases of septicemia attributable to *Y. enterocolitica* in a similar patient population. One of the blood isolates in the present study was from a previously healthy 3-month-old infant. *Y. enterocolitica* bacteremia in infants is apparently on the increase (8, 9, 28) in the United States and occurs with or without concomitant acute or chronic gastrointestinal symptomatology.

TABLE 1. Data relative to 56 *Y. enterocolitica* isolates studied at The Mount Sinai Hospital (1974 to 1982)

Date (mo/yr)	Age	Sex	Source	Serogroup	Biotype	Location
5/1974	13 yr	M	Mesenteric lymph node[a]	O:8	1	Queens, N.Y.
3/1976	48 yr	F	Blood	O:8	1	Brooklyn, N.Y.
7/1976	1 yr	F	Mesenteric lymph node	O:8	1	New York City
10/1976	3 wk	F	Blood	O:5,27	2	Brooklyn, N.Y.
6/1977	5 mo	M	Stool	O:8	1	Brooklyn, N.Y.
6/1977	80 yr	F	Blood	O:1	3	Long Island, N.Y.
7/1977	17 yr	M	Blood	O:5,27	2	Long Island, N.Y.
7/1977	77 yr	M	Blood	NT[b]	1	Queens, N.Y.
7/1977	32 yr	F	Blood	O:12	1	Queens, N.Y.
9/1978	9 mo	F	Stool	O:5,27	2	New Jersey
10/1978	1 yr	F	Stool	O:3	4	Brooklyn, N.Y.
12/1978	57 yr	M	Sputum[a]	NT	1	New York City
12/1978	76 yr	F	Kidney abscess	O:3	4	Queens, N.Y.
1/1979	5 wk	F	Stool	O:3	4	Bronx, N.Y.
1/1979	50 yr	M	Sputum[a]	O:14	1	New York City
1/1979	76 yr	M	Blood	O:3	4	Long Island, N.Y.
1/1979	5 wk	M	Stool	O:1,2,3	3	Bronx, N.Y.
1/1979	4 wk	M	Stool	O:5,27	3	Brooklyn, N.Y.
6/1979	28 yr	M	Stool	NT	1	New York City
6/1979	1 mo	F	Stool	O:3	4	New York City
6/1979	—[c]	F	Stool	O:1,2,3	3	New York City
7/1979	64 yr	F	Blood[a]	O:1,2,3	3	New York City
9/1979	3 yr	M	Stool	O:8	1	Watertown, N.Y.
12/1979	76 yr	M	Blood	O:5,27	2	Queens, N.Y.
12/1979	—	—	Stool	O:3	4	New York City
1/1980	2 yr	M	Stool	O:8	1	Watertown, N.Y.
2/1980	—	—	Blood	O:5,27	2	New York City
4/1980	2 mo	M	Stool	O:3	4	Brooklyn, N.Y.
4/1980	—	—	Stool	O:3	4	Bronx, N.Y.
5/1980	Adult	—	Blood	O:3	4	Maine
6/1980	6 mo	M	Stool	O:3	4	Brooklyn, N.Y.
6/1980	31 yr	M	Appendix	O:8	1	New Jersey
7/1980	1 yr	F	Stool	O:5,27	2	Brooklyn, N.Y.
7/1980	6 mo	F	Mesenteric lymph node	O:8	1	Bronx, N.Y.
7/1980	6 mo	F	Stool	O:8	1	Bronx, N.Y.
7/1980	—	—	Stool	O:5,27	2	New York City
9/1980	3 yr	M	Stool	O:3	4	Brooklyn, N.Y.
12/1980	1 yr	F	Stool	O:3	4	Brooklyn, N.Y.
1/1981	2 mo	M	Stool	O:3	4	Mt. Vernon, N.Y.
1/1981	—	—	Sputum	O:5,27	1	Brooklyn, N.Y.
3/1981	6 mo	M	Stool	O:3	4	Mt. Vernon, N.Y.
6/1981	62 yr	M	Blood	O:5,27	2	Washington, D.C.
7/1981	55 yr	M	Abdominal pus	O:8	1	New York City
9/1981	4 mo	F	Stool[a]	O:3	4	New York City
9/1981	4 mo	M	Stool[a]	O:3	4	New York City
10/1981	46 yr	M	Stool	O:3	4	New York City
10/1981	5 yr	F	Stool	O:3	4	New York City
11/1981	6 mo	F	Stool	O:3	4	Mt. Vernon, N.Y.
11/1981	76 yr	F	Blood	O:3	4	New Jersey
11/1981	8 yr	F	Stool	O:3	4	New York City
12/1981	3 mo	F	Blood	O:3	4	Bronx, N.Y.
1/1982	3 mo	F	Stool	O:3	4	Brooklyn, N.Y.
3/1982	2 mo	F	Stool	O:3	4	Long Island, N.Y.
3/1982	4 yr	F	Stool	O:3	4	Mt. Vernon, N.Y.
3/1982	8 mo	M	Stool	O:3	4	Valhalla, N.Y.
5/1982	18 mo	M	Stool	O:3	4	Bronx, N.Y.

[a] Isolated at The Mount Sinai Hospital.
[b] NT, Nontypable.
[c] —, Unknown.

TABLE 2. Serogroup distribution of 14 *Y. enterocolitica* blood isolates

Serogroup	No. of isolates
O:5,27	5
O:3	4
O:8	1
O:1,2,3	1
O:1	1
O:12	1
Nontypable	1

The serogroup distribution of the 14 *Y. enterocolitica* blood isolates was also noteworthy (Table 2). Earlier reports of *Y. enterocolitica* bacteremia in the United States have shown the predominance of serogroup O:8 isolates (3, 17, 32, 38), whereas the present survey revealed a predominance of isolates of serogroups O:5,27 and O:3 and only one isolate of serogroup O:8. Although serogroup O:5 *Y. enterocolitica* has been reported as an agent of bacteremia (11, 21, 31), serogroup O:5,27 (biotype 2) is apparently emerging as a significant human pathogen: the present report shows the propensity of this serogroup to produce bacteremia, gastroenteritis, or both; Bissett (3) documented one blood isolate and seven stool isolates of serogroup O:5,27; and Snyder et al. (30) reported three biotype 2 blood isolates among 74 *Y. enterocolitica* isolates.

Perhaps the most striking finding in the present survey is that serogroup O:3 isolates accounted for 49% (27 of 56) of all strains (Table 3). These biotype 4, phage type 9b isolates were first found in New York City in October 1978, when an isolate was recovered from a 1-year-old infant hospitalized at the Kings County Hospital, Brooklyn. After this isolation, this "Canadian" (36) strain was increasingly recovered from diverse human clinical sources, (e.g., stools, renal abscess, blood) through 1980, when 12 biotype 4, phage type 9b isolates were documented, along with an array of other *Y. enterocolitica* serogroups (Table 1).

Since 1981, however, with the exception of two serogroup O:5,27 isolates and one O:8 isolate, the remaining 15 *Y. enterocolitica* isolates forwarded for confirmation have been of serogroup O:3, biotype 4, phage type 9b (Fig. 1).

TABLE 3. Serogroup distribution of the 56 *Y. enterocolitica* isolates studied

Serogroup	No. (%) of isolates
O:3	27 (49)
O:5,27	10 (18)
O:8	10 (18)
O:1,2,3	3 (5.5)
O:1	1 (0.2)
O:12	1 (0.2)
O:14	1 (0.2)
Nontypable	3 (5.5)

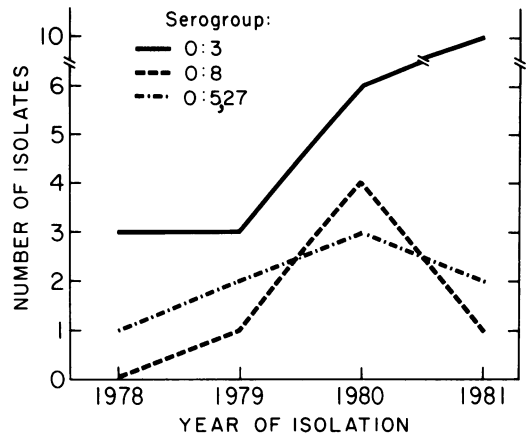

FIG. 1. Incidence of *Y. enterocolitica* isolates of serogroups O:3, O:8, and O:5,27 recovered in the New York City area.

Several questions about the introduction of serogroup O:3 *Y. enterocolitica* into the United States remain to be answered. Since 1934, 137 *Y. enterocolitica* serogroup O:8 isolates in the United States have been reported (Table 4), whereas serogroup O:3 isolates have been recovered on only 16 occasions (total of five reports) since 1976. Serogroup O:3 infections have been documented in California (1 case) (3), Michigan (1 case) (35), Pennsylvania (1 case) (22), Wisconsin (2 cases) (30), and the state of New York (11 cases) (29). In each instance, as with the 27 patients with serogroup O:3 isolates encountered in the present study, none of the patients gave a history of travel outside of his or her geographic locale. The mode of acquisition of this particular *Y. enterocolitica* serogroup, especially for patients who were exclusively urban dwellers has yet to be determined. To date, although Doyle and colleagues (12) have recovered *Y. enterocolitica* of serogroups O:3 and O:8 from the tongues of farm-raised pigs in Wisconsin, an animal or environmental source of serogroup O:3 (as well as serogroup O:8) has not yet been uncovered in New York City. Yet there appears to be a clustering of the majority of serogroup O:3 isolates within a restricted area (25-mile [ca. 400-km] radius) circumscribing New York City. Such a distribution of serogroup O:3 *Y. enterocolitica* strains in an urban area heretofore devoid of these strains bespeaks the establishment of a nidus (animate or inanimate) within this locale. Serogroup O:3 may already have a national distribution, as attested to by isolations in California, the central states, and

TABLE 4. Reported human isolates of *Y. enterocolitica* in the United States: 1934 to 1982

Year(s)	Source(s)[a]	State(s) of origin	No. of isolates	No. of serogroup:			Reference(s)
				O:3	O:8	Others	
1934–1939	Feces, facial abscess	N.Y.	5	0	5	0	20, 25
1968–1973	Blood, CSF, MLN, spleen	Mo., Conn., Ky., N.C.	4	0	4	0	7, 15, 27, 32
1973	Various	13 states	29	0	15[b]	14	38
1974–1975	Blood, MLN, feces	N.Y., Calif.	4	0	3	1	6, 14, 16, 17
1976	Various	Calif.	24	1	6	17	3
1976–1978	Feces, blood, rib abscess	Ga., Ind., Ky., Md., Tenn., Ill.	10	0	2	8	9, 18, 19, 26, 31, 34, 40
1978	Feces	N.Y.	39	0	38	1	4
1978	Osteomyelitis	Mich.	1	1	0	0	35
1979–1981	Feces, CNS, lung, MLN, mycotic aneurysm, wound	Wash., D.C., Mo., N.C., N.Y., Pa., Fla.	22	1	8[c]	13	1, 2, 8, 10, 13, 22, 24, 28, 39
1981	Various	N.Y.	120	11[d]	59	50	29
1982	Feces, blood	Wis.	74	2	0	72	30

[a] CSF, Cerebrospinal fluid; MLN, mesenteric lymph node; CNS, central nervous system.
[b] Three serogroup O:8 isolates had been reported earlier (7, 27, 33).
[c] Six isolates were reported as indole positive, biotype 1 (classified by the Wauters scheme) and correspond to serogroup O:8.
[d] Two serogroup O:3 isolates were included in the present report.

the eastern seaboard, including Maine (Table 1).

The introduction of serogroup O:3 *Y. enterocolitica* into the continental United States may have important clinical and epidemiological impact. The presence of this enteroinvasive *Y. enterocolitica* serogroup may herald more protracted and systemic infections, especially bacteremia with secondary invasion of endothelial, visceral, and osseous tissues. Serogroup O:3 strains have been shown to possess plasmids coding for pathogenic properties (adherence, cytotoxicity to HEp-2 cells [37]) and possibly production of the virulence-associated VW-antigen complex (23), and these traits could be transferred to avirulent, non-O:8, biotype 1 strains of *Y. enterocolitica*, which are encountered in humans and abound in the environment (29).

Epidemiologically, it seems critical that microbiologists and clinicians reporting *Y. enterocolitica* infections indicate at least the biotype, and when possible, also the serogroup, of isolates. Emergence of strains of a particular serogroup of *Y. enterocolitica* in areas where none existed previously suggests an ecological shift toward the establishment of a new reservoir or vector for these strains. Although most of the earlier documented outbreaks of yersiniosis have occurred among rural dwellers, the establishment of a reservoir for *Y. enterocolitica*, especially serogroup O:3, in urban committees raises the potential for yersiniosis outbreaks.

ADDENDUM

Since the submission of this paper, four additional *Y. enterocolitica* isolates of serogroup O:3 have been recovered—three from stool cultures and one from bone marrow.

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