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Antibiotic susceptibilities of *Yersinia enterocolitica* recovered from children over a 12-year period☆

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Abstract

Antibiotic susceptibility testing by the microdilution technique was performed on 184 *Yersinia enterocolitica* isolates recovered from children with gastroenteritis in the Detroit area during a 12-year period. The majority of isolates were resistant to ampicillin, ticarcillin and cefazolin. The most active agents were cefotaxime, ceftriaxone, cefepime, gentamicin, tobramycin, sulphamethoxazole/trimethoprim, imipenem and ciprofloxacin. Cefotaxime and ceftriaxone were effective in the treatment of bacteraemia in 12 patients.

Keywords: *Yersinia enterocolitica*; Susceptibility; Children

1. Introduction

Yersinia enterocolitica is a Gram-negative bacterium that can cause illnesses ranging from self-limiting enteritis to life-threatening bacteraemia [1,2]. *Yersinia enterocolitica* has been identified as an important cause of enteritis in Canada and Europe [3,4]. Studies have also shown that it is associated with enteritis among infants in urban communities in the USA, particularly around the winter holidays [5,6]. The role of antimicrobial treatment in uncomplicated *Y. enterocolitica* is controversial. However, systemic infection and bacteraemia require treatment with antibiotics. Local susceptibility data may assist clinicians in choosing appropriate antibiotic therapy. Reports of antimicrobial susceptibility from different parts of the world indicate that *Y. enterocolitica* is susceptible to a wide range of antimicrobial agents [7–14]. However, no systematic study of the antimicrobial susceptibilities of clinical isolates of *Y. enterocolitica* recovered from US children has been reported. This study was undertaken to determine the antimicrobial susceptibility pattern of *Y. enterocolitica* isolates recovered from children during a 12-year period to each of 21 antibiotics.

2. Methods

The study included all patients with positive stool cultures for *Y. enterocolitica* seen at our hospital between 1990 and 2002. Demographic data, microbiological data, the incidence of bacteraemia and treatment of patients with bacteraemia were investigated. The Children's Hospital of Michigan is a 260-bed, tertiary care teaching paediatric institution.

Stool specimens were inoculated onto sheep blood, MacConkey, Hektoen Enteric and cefsulodin–irgasan–novobiocin (CIN) agars (Becton Dickinson Microbiology Systems, Cockeysville, MD). Plates were incubated at 35 °C, except the CIN agar that was incubated at 30 °C, for 48 h. Oxidase-negative colonies were identified using the API-20E identification system (bioMerieux, Durham, NC). Bacter-

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aemia was defined as a positive blood culture for *Y. enterocolitica* obtained from a peripheral vein. Blood cultures were processed using the BACTEC 9240 instruments utilising fluorescent technology (Becton Dickinson Diagnostic Instrument System, Towson, MD) or the paediatric isolator (Wampole Laboratories, Cranbury, NJ). Susceptibility testing was performed by the MicroScan microdilution technique (Dade Behring Inc., West Sacramento, CA) to determine the minimum inhibitory concentration (MIC) of each of the 21 antibiotics. Antimicrobial susceptibility was defined according to the interpretive breakpoints recommended by the National Committee for Clinical Laboratory Standards [15]. During the study period not all antimicrobial agents were tested against all isolates; as a result, and because of the retrospective nature of the study, the number of isolates tested for each antibiotic varied.

3. Results

Over a 12-year period, enteric bacterial pathogens were recovered from 1920 patients. *Yersinia enterocolitica* was isolated from 201 patients, representing 10.5% of all enteric pathogens. The age range of the 201 study patients was 15 days to 14 years (mean 10.3 months, median 6 months). All children except two were African-American. The male to female ratio was 1:1.3. One hundred and seventy-two (86%) children presented during the months of November, December and January. One hundred and sixty-nine (84%) were ≤1 year of age and 44 (22%) were ≤3 months of age. Common findings among our *Y. enterocolitica*-infected patients included fever, vomiting, bloody stools and leukocytosis.

Antimicrobial susceptibility data were available for 184 single patient isolates (Table 1). All tested isolates were susceptible to cefotaxime (184/184), ceftriaxone (184/184), cefepime (26/26), gentamicin (183/183), tobramycin (183/183), ciprofloxacin (27/27), piperacillin/tazobactam (26/26), ticarcillin/clavulanic acid (27/27) and sulphamethoxazole/trimethroprim (184/184). Resistance to ampicillin (MIC ≥ 32 μg/mL) and ticarcillin (MIC ≥ 128 μg/mL) was detected in 87.2% and 86.6% of isolates, respectively. However, 78% of *Y. enterocolitica* isolates were susceptible to piperacillin. Most isolates were susceptible to cefuroxime (81%) and ceftazidime (83%). The majority of ceftazidime-resistant strains had high-level resistance (MIC ≥ 32 μg/mL). The pattern of antimicrobial susceptibility was constant during the 12-year study period. No apparent trends regarding acquisition of resistance were noted over time (data not shown).

Twelve of one hundred (12%) children who had blood cultures drawn had *Y. enterocolitica* bacteraemia, seven of whom were females. Of the 12 children with bacteraemia, 10 (83%) were younger than 1 year and 8 (67%) were younger than 3 months of age. When compared with infants aged 3–12 months, the odds ratio for bacteraemia in infants younger than 3 months of age was 12.556 (95% confidence interval 2.854–54.407). Eleven children with bacteraemia were treated with cefotaxime or ceftriaxone, and one infant whose course was complicated by pneumatosis intestinalis was treated with cefotaxime, ampicillin and metronidazole. All bacteraemic children recovered.

Table 1
Antimicrobial susceptibilities of *Yersinia enterocolitica*

Antimicrobial agent	No. of isolates	Susceptible		Intermediate		Resistant	
		Breakpoint (μg/mL)	Isolates (%)	Breakpoint (μg/mL)	Isolates (%)	Breakpoint (μg/mL)	Isolates (%)
Ampicillin	180	≤8	3 (2)	16	20 (11)	≥32	157 (87)
Ampicillin/sulbactam	26	≤8/4	19 (73)	16/8	5 (19)	>16/8	2 (8)
Ceftriaxone	184	≤8	184 (100)	16–32	0 (0)	≥64	0 (0)
Ceftazidime	183	≤8	151 (83)	16	20 (11)	≥32	12 (7)
Cefotaxime	184	≤8	184 (100)	16–32	0 (0)	≥64	0 (0)
Cefazolin	181	≤8	3 (2)	16	14 (8)	≥32	164 (91)
Chloramphenicol	157	≤8	156 (99)	16	0 (0)	≥32	1 (1)
Ciprofloxacin	27	≤1.0	27 (100)	2	0 (0)	≥4	0 (0)
Cefepime	26	≤8	26 (100)	16	0 (0)	≥32	0 (0)
Cefpodoxime	25	≤2	13 (52)	3	8 (32)	≥8	4 (16)
Cefuroxime	183	≤8	149 (81)	16	19 (10)	≥32	15 (8)
Cefotetan	24	<16	24 (100)	32	0 (0)	≥64	0 (0)
Gentamicin	183	≤4	183 (100)	8	0 (0)	≥16	0 (0)
Imipenem	27	≤4	27 (100)	8	0 (0)	≥16	0 (0)
Ofloxacin	26	≤2	26 (100)	4	0 (0)	≥8	0 (0)
Piperacillin	183	≤16	143 (78)	32–64	17 (9)	≥128	23 (13)
Piperacillin/tazobactam	26	≤16/4	26 (100)	32/4–64/4	0 (0)	≥128/4	0 (0)
Ticarcillin	157	≤16	3 (2)	32–64	18 (11)	≥128	136 (87)
Ticarcillin/clavulanic acid	27	≤16/2	27 (100)	32/2–64/2	0 (0)	≥128/2	0 (0)
Tobramycin	183	≤4	183 (100)	8	0 (0)	≥16	0 (0)
Sulphamethoxazole/trimethoprim	184	≤2/38	184 (100)	–	0 (0)	≥4/76	0 (0)