Unfortunately, we did not include environmental strains in our collection. All isolates were highly susceptible to the quinolones, as reported previously for *Aeromonas* and other enteric pathogens (3, 14).

Our findings suggest that identification of *Aeromonas* isolates to the species level may have important implications for the selection of a species-oriented antimicrobial therapy in infections in which these organisms are involved. Of the antibacterial agents tested, aztreonam, third-generation cephalosporins, chloramphenicol or one of the quinolones could be considered for therapy of these infections. The low MICs and high concentrations attainable in faeces indicate that quinolones might be excellent drugs for treatment of *Aeromonas*-associated diarrhoea. Another advantage of quinolones is that, in spite of their very high concentrations in faeces, the effect on the lower intestinal microflora is only moderate in comparison with that of the other antibacterial agents recommended for therapy (15).

References


Susceptibility of *Bacteroides* non-fragilis and Fusobacteria to Amoxicillin, Amoxicillin/Clavulanate, Ticarcillin, Ticarcillin/Clavulanate, Cefoxitin, Imipenem and Metronidazole

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The susceptibility of 234 *Bacteroides* non-fragilis strains and 56 fusobacteria from 12 European centers to amoxicillin, amoxicillin/clavulanate, ticarcillin, ticarcillin/clavulanate, cefoxitin, imipenem and metronidazole was tested and related to beta-lactamase production. Beta-lactamase production was detected in 42.3% of the *Bacteroides* strains and 26.8% of the fusobacteria. The MIC90 of amoxicillin for beta-lactamase-negative strains was 0.5 μg/ml and the

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MIC90 of ticarcillin 2.0 µg/ml. In the case of β-lactamase-positive strains the MIC90 of amoxicillin (32 µg/ml) and ticarcillin (16 µg/ml) dropped to ≤ 1.0 µg/ml upon addition of clavulanate; 65.8% of these strains were susceptible to amoxicillin and 98.2% to ticarcillin, but all were susceptible when clavulanate was added. All strains were susceptible to imipenem and metronidazole, and 99.3% to cefoxitin.

Gram-negative anaerobic bacteria are established as important pathogens, especially in patients with weakened host defences (1, 2). Although the Bacteroides fragilis group comprises the most important group of anaerobic gram-negative pathogens, infections with other Bacteroides species and fusobacteria are increasingly encountered (1-4). In recent years, the antimicrobial susceptibility pattern of Bacteroides non-fragilis group anaerobic gram-negative rods has gradually changed. Beta-lactamase production and resistance to β-lactams has been reported for Bacteroides bivius, Bacteroides disiens, the black-pigmented Bacteroides group, Bacteroides oris/buccae, Bacteroides oralis, Bacteroides splanchicus, Bacteroides coagulans, Bacteroides ureolyticus, Micromonospora multicauda and Megamonas hypermegas (2, 5-7). Beta-lactamase production and resistance to β-lactams has also recently been reported for fusobacteria, notably Fusobacterium nucleatum (8, 9).

To monitor current susceptibility patterns of organisms such as Bacteroides non-fragilis group anaerobic gram-negative rods, periodic country-wide surveys have been performed using standardized techniques and organisms isolated within 1 to 2 years prior to the evaluation (9). A few such studies have been published in Europe (10-12). The present study utilized standardized methods to evaluate β-lactamase production and susceptibility of 234 Bacteroides non-fragilis strains and 56 fusobacteria isolated within two years prior to the survey in 12 centers in Europe. Susceptibility to amoxicillin, amoxicillin/clavulanate, ticarcillin, ticarcillin/clavulanate, cefoxitin, imipenem and metronidazole was tested.

Results and Discussion. Results of susceptibility testing are presented in Tables 1 and 2. As can be seen, 84.6% of all Bacteroides strains and 92.9% of fusobacteria were susceptible to amoxicillin; corresponding figures for ticarcillin were 99.6% and 98.2%, respectively. All strains were susceptible to amoxicillin and ticarcillin when clavulanate was added (Table 1). When results of β-lactamase positive strains were analysed separately, geometric mean MICs for all strains dropped from 2.7 µg/ml (MIC90 32 µg/ml) and 3.2 µg/ml (MIC90 16 µg/ml) to 0.2 µg/ml (MIC90 0.5 µg/ml) and 0.6 µg/ml (MIC90 1.0 µg/ml) for amoxicillin and ticarcillin, respectively (Table 2). Addition of clavulanate raised the rates of β-lactamase positive strains susceptible to amoxicillin and ticarcillin from 65.8% and 98.2% to 100%. In the case of two β-lactamase positive strains (1 Bacteroides bivius, 1 Fusobacterium naviforme), for which the amoxicillin MIC was 1.0 µg/ml and the ticarcillin MIC 2.0 µg/ml, no synergy was seen with clavulanate. No significant differences in antimicrobial susceptibility between laboratories was observed.

Materials and Methods. The organisms tested were all clinical isolates obtained from hospitals in Edinburgh, Berlin, Brussels, Ghent, Amsterdam, Paris, La Balme les Grottes (France), Helsinki, Rome and Seville. Strains were transported to Hershey Medical Center, Hershey, PA, USA, and stored at −70°C in sterile defibrinated sheep blood. Prior to testing, strains were checked for purity by first subculturing on kanamycin/vancomycin plates (Bacteroides) or josamycin/neomycin plates (fusobacteria) (2), and subsequently plated on Brucella blood agar without antibiotics. Identification was performed by standard methods (1, 2).

Beta-lactamase testing was done by the nitrocefin disk method, as previously described (13). Antimicrobial susceptibility testing was performed by the agar dilution method recommended by the NCCLS using Wilkins-Chalgren agar supplemented with 5% added sterile defibrinated sheep blood (14). Quality controls included with each run included Bacteroides fragilis ATCC 25285 and Bacteroides thetaiotaomicron ATCC 29741 (MICs: amoxicillin 16 µg/ml, ticarcillin 32 µg/ml, amoxicillin/clavulanate and ticarcillin/clavulanate 0.125-0.5 µg/ml, cefoxitin 8 µg/ml, imipenem 0.25-0.5 µg/ml, metronidazole < 0.5 µg/ml). With the exception of imipenem, where a single screening plate of 2 µg/ml was used, and cefoxitin, where the new NCCLS breakpoint of 32 µg/ml was used, dilutions and susceptibility breakpoints were as described previously (14). Clavulanate was added to β-lactams at a fixed concentration of 2 µg/ml and also tested alone to ensure that the concentration used was at least four-fold below the MIC of clavulanate.