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Antimicrobial Susceptibility of *Arcanobacterium haemolyticum*

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The susceptibilities of 138 clinical isolates of *Arcanobacterium haemolyticum* to 11 antimicrobial agents were tested. All strains were susceptible to phenoxymethylpenicillin, cephalosporins, erythromycin, azithromycin, clindamycin, vancomycin, doxycycline, and ciprofloxacin but were resistant to trimethoprim-sulfamethoxazole.

Arcanobacterium haemolyticum (formerly *Corynebacterium haemolyticum* [6, 3]) is an infrequent cause of pharyngitis in children and young adults and occasionally is isolated from wound infections and abscesses as well as found in meningitis, pneumonia, and septicemia patients (9). There are only a few reports of the susceptibility of *A. haemolyticum* to antimicrobial agents, and only the MICs to penicillin and erythromycin have been reported (1, 8). We determined MICs of 11 antimicrobial agents for 138 *A. haemolyticum* strains.

A. haemolyticum strains tested were clinical isolates collected by our laboratories and other Finnish clinical microbiology laboratories between 1989 and 1992. Of the isolates, 43 were from throat, 91 from wound, and 3 from maxillary sinus cultures and one was from blood. Arcanobacteria were identified by typical colony morphology and by Gram-stain, catalase, DNase, carbohydrate utilization, lipase, and reverse CAMP tests (2). The antimicrobial agents tested were phenoxymethylpenicillin (Orion Pharmaceuticals, Espoo, Finland), cephalexin (Orion), cefuroxime (Glaxo Operations, Ltd., Greenford, England), cefotaxime (Hoechst AG, Frankfurt, Germany), erythromycin (Orion), azithromycin (Pfizer GmbH, Karlsruhe, Germany), doxycycline (Orion), ciprofloxacin (Bayer, Leverkusen, Germany), clindamycin (Upjohn Co., Kalamazoo, Mich.), vancomycin (Eli Lilly and Co., Indianapolis, Ind.), and trimethoprim-sulfamethoxazole (Orion).

The MICs were determined by the agar dilution method (7) on Mueller-Hinton II agar (BBL, Cockeysville, Md.) supplemented with 5% defibrinated sheep blood and 1% IsoVitalex (BBL). Bacteria harvested from sheep blood agar plates after 48 h of incubation at 35°C in a candle jar were suspended in 0.9% saline and adjusted to a density of approximately 0.5 on the McFarland turbidity standard. The suspension was further diluted 1 in 10 in saline. With a multipoint inoculator (Mast Laboratories Ltd., Bootles, England), a final inoculum of approximately 10^4 CFU was delivered onto Mueller-Hinton plates. The Mueller-Hinton plates were incubated overnight at 35°C in ambient air. The MIC was determined as the lowest concentration of the antimicrobial agent that inhibited macroscopic growth. The following control organisms were inoculated on each plate: *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 29213 and *A. haemolyticum* ATCC 9345.

The susceptibilities of the *A. haemolyticum* isolates to the antimicrobial agents tested are given in Table 1. The MICs (micrograms per milliliter) for the type strain *A. haemolyticum* ATCC 9345 were as follows: phenoxymethylpenicillin, ≤0.12; cephalexin, 2.0; cefuroxime, 0.25; cefotaxime, ≤0.06; erythromycin, ≤0.06; azithromycin, ≤0.06; doxycycline, 0.12; ciprofloxacin, 0.5; clindamycin, ≤0.06; vancomycin, 0.5; and trimethoprim-sulfamethoxazole, >8/152. Arcanobacteria were susceptible to phenoxymethylpenicillin, with a MIC for 90% of strains tested (MIC_{90}) of 0.12 μg/ml. In previous reports, the MICs of phenoxymethylpenicillin were between 0.015 and 1.0 μg/ml (1, 8). We found no resistant strains, and 0.25 μg of phenoxymethylpenicillin per ml inhibited the growth of all strains. There was no difference in the penicillin MICs for strains derived from throat and other cultures. All strains were susceptible to cephalosporins, but the MICs of cephalexin were higher than those of cefuroxime and cefotaxime. The MIC_{90}s were 2, 0.25, and 0.06 μg/ml, respectively. All strains were susceptible to erythromycin (MIC_{90}, 0.06 μg/ml), azithromycin (MIC_{90}, 0.06 μg/ml), and clindamycin (MIC_{90}, 0.06 μg/ml). The susceptibilities of *A. haemolyticum* strains to cephalosporins, clindamycin, azithromycin, and ciprofloxacin have not been reported before, but in a previous report all *A. haemolyticum* strains were susceptible to erythromycin, with a MIC of 0.06 μg/ml (1). All strains tested here were susceptible to vancomycin, with a MIC of 0.5 μg/ml. A few fecal isolates of *A. haemolyticum* have previously been shown to be resistant to vancomycin and to harbor the transferable vancomycin resistance gene *vanA* (4). By the disk diffusion method, *A. haemolyticum* has been reported to be resistant to trimethoprim-sulfamethoxazole (5). This was confirmed by the MIC_{90}s of >8/152 μg/ml obtained in this study.

The clinical isolates of *A. haemolyticum* tested here were uniformly susceptible to the antimicrobial agents studied, except trimethoprim-sulfamethoxazole. Treatment of pharyngitis with penicillin may, however, fail to eradicate *A. haemolyticum* (9), and clinical failures have been reported (1, 9). Whether these are associated with the penicillin tolerance reported to be common in *A. haemolyticum* strains (8) is not established. Erythromycin has also been used in the treatment of *A. haemolyticum* infections (1, 9), while there are no reports of the clinical efficacy of the other agents tested in this study.

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TABLE 1. MICs of 11 antimicrobial agents for *A. haemolyticum* (n = 138)

Antimicrobial agent	MIC (μg/ml)			NCCLS breakpoints[a] in μg/ml (susceptible/resistant)
	Range	50%	90%	
Phenoxymethylpenicillin[b]	≤0.12–0.25	0.12	0.12	≤0.12/≥4
Cephalexin[c]	≤0.12–8	1	2	≤8/≥32
Cefuroxime	≤0.06–0.5	0.12	0.25	≤8/≥32
Cefotaxime	≤0.06	0.06	0.06	≤8/≥64
Erythromycin	≤0.06	0.06	0.06	≤0.5/≥8
Azithromycin[d]	≤0.06	0.06	0.06	≤0.5/≥8
Doxycycline[e]	≤0.06–8	0.12	0.12	≤4/≥16
Ciprofloxacin	≤0.12–2	0.5	0.5	≤1/≥4
Clindamycin	≤0.06	0.06	0.06	≤0.5/≥4
Vancomycin	≤0.25–0.5	0.5	0.5	≤4/≥32
Trimethoprim-sulfamethoxazole	>8/152	>8/152	>8/152	≤2/38/≥4/76

[a] See reference 7. NCCLS, National Committee for Clinical Laboratory Standards.
[b] Breakpoints of penicillin G for nonenterococcal streptococci used.
[c] Breakpoints for cephalothin used.
[d] NCCLS breakpoints not available; those for erythromycin used.
[e] Breakpoints for tetracycline used.

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