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Susceptibility of *Propionibacterium acnes* to Seventeen Antibiotics

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The in vitro susceptibility of 96 isolates of *Propionibacterium acnes* to 17 antibiotics was determined by utilizing an agar dilution technique. With the exception of the aminoglycosides, these organisms are susceptible to virtually all of the commonly used antimicrobial agents.

Propionibacterium species are unusual causes of illness, but are known to produce a variety of infections (4, 6). Only a few in vitro antibiotic susceptibility studies against these organisms have been made in which multiple antibiotics and/or large numbers of isolates were used (1, 7, 10).

In the present study, we have examined the in vitro susceptibility of 96 strains of *P. acnes* to 17 antibiotics, including several antimicrobial agents not previously tested against *P. acnes* (1, 7, 10). Of particular interest is the susceptibility of these organisms to cephalosporins and semisynthetic penicillins, because these drugs are frequently used as prophylaxis in procedures such as cerebrospinal fluid shunts and cardiac valvular surgery where *Propionibacterium* infections are prone to occur (4, 6).

The majority of the 96 strains studied were clinical isolates from the microbiology laboratories of the Veterans Administration Hospital, Colorado General Hospital, and St. Joseph Hospital, Denver, Colo. Eleven strains, five with known minimal inhibitory concentration (MIC) values by broth dilution, were supplied by George Lombard of the Center for Disease Control (CDC), Atlanta, Ga. Speciation was done by standard methods (2, 5, 8).

The antibiotics tested are indicated in Table 1. Antimicrobial susceptibility was done by using the agar dilution technique on brain heart infusion agar supplemented with hemin (5 μg/ml) and vitamin K (0.5 μg/ml). Stock solutions of the test drugs were prepared in sterile distilled water; further dilutions were made in brain heart infusion broth supplemented with hemin (5 μg/ml) and vitamin K_1 (1.0 μg/ml) and added to similarly supplemented brain heart infusion agar at 46°C to yield final drug concentrations ranging from 0.1 to 50 μg/ml. The antibiotic-containing plates were stored at 4 to 8°C for not longer than 5 days and were reduced in an anaerobic chamber for 24 h before use.

The inoculum was prepared by diluting a 24-h supplemented brain heart infusion broth culture to provide an inoculum size of approximately 10^4 colony-forming units—a Steers replicator was then used to deliver the diluted inoculum to the surface of the agar (9). After inoculation, all plates were incubated in an anaerobic chamber at 36°C. After 48 h of incubation, the MIC values were read as the lowest concentration permitting no growth, a barely visible fine haze, or not more than one discrete colony (3). A limited number of antibiotic dilutions and inoculating procedures, not requiring more than 30 min, were done at ambient atmosphere. All other steps were done in an anaerobic chamber.

Table 1 shows the cumulative percentages of the strains of *P. acnes* inhibited at various concentrations of 17 antibiotics. Ninety-six strains of *P. acnes* were susceptible to all antibiotics tested, except the aminoglycosides: gentamicin, tobramycin, and amikacin. These results are in general agreement with the published data (1, 7, 10). Penicillin G and erythromycin were the most active, inhibiting all strains at 0.1 μg/ml. The MICs of the semisynthetic penicillins were higher than penicillin, but were within the range of achievable blood levels.

Cephalothin was the most active cephalosporin tested. Clindamycin showed activity comparable to cephalothin. The MICs of chloramphenicol and vancomycin were similar, with 100% inhibition at 1.6 and 0.8 μg/ml, respectively. Gentamicin inhibited 100% of the strains at 50 μg/ml and 76% at 25 μg/ml. Tetracycline inhibited all of the strains at 3.1 μg/ml and 64% at 1.6 μ/ml.

The CDC MICs of seven antibiotics against

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the five strains, by broth dilution, are compared with our results in Table 2. Some of the differences may be more apparent than real, because the lowest test concentration in our method was 0.1 μg/ml, whereas the minimal concentration tested by the CDC method was 0.01 μg/ml. Our MICs for gentamicin and tetracycline are substantially higher than those of the CDC, although our results are similar to those obtained by Martin (7), who also used an agar dilution method. As with certain facultative organisms, the differences in MICs of gentamicin and tetracycline, between the two methods, could possibly be due to the differences in concentrations of divalent ions and pH of the media (3). Nevertheless, these discrepancies between broth and agar dilution methods point out the need for a standardized susceptibility test method for *P. acnes*.

The MIC results from this study indicate that *P. acnes* is susceptible to almost all commonly used antibiotics, including the cephalosporins and semisynthetic penicillins, which are frequently used for prophylaxis in certain neurosurgical and cardiovascular procedures. Our results also indicate that *P. acnes* is not susceptible to some of the commonly used aminoglycosides.

TABLE 1. *Susceptibility of propionibacterium acnes to 17 antibiotics*

Antibiotics	No. of strains tested	Cumulative % of organisms inhibited at various concn (μg/ml)									
		0.1	0.2	0.4	0.8	1.6	3.1	6.2	12.5	25.0	50.0
Penicillins											
Ampicillin	96	65	99	99	100						
Dicloxacillin	90	3	3	19	78	98	100				
Methicillin	96	12	26	47	89	91	99	100			
Nafcillin	96	16	48	83	97	98	100				
Oxacillin	96	43	79	88	100						
Penicillin G	96	100									
Cephalosporins											
Cephalexin	95		1	56	97	99	100				
Cefoxitin	96	51	98	100							
Cephalothin	96	92	99	100							
Aminoglycosides											
Amikacin	96						1		2	58	92
Gentamicin	96				2	2	9	32	64	76	100
Tobramycin	96									2	13
Others											
Chloramphenicol	94	1	5	29	94	100					
Clindamycin	95	94	96	100							
Erythromycin	96	100									
Tetracycline	96			4	23	64	100				
Vancomycin	96			5	100						

TABLE 2. *MICs (μg/ml) of five strains of propionibacterium acnes: agar dilution versus broth dilution method*[a]

Antibiotic	MIC (μg/ml) in strain no.									
	1		3		7		92		95	
	Agar	Broth	Agar	Broth	Agar	Broth	Agar	Broth	Agar	Broth
Cephalothin	≤0.1	0.06	≤0.1	0.06	0.2	0.12	≤0.1	0.5	≤0.1	0.06
Chloramphenicol	0.8	0.5	0.8	0.25	0.8	0.5	0.4	1.0	0.4	0.25
Clindamycin	0.2	0.12	≤0.1	≤0.015	≤0.1	≤0.015	≤0.1	0.03	≤0.1	0.03
Erythromycin	≤0.1	≤0.015	≤0.1	≤0.015	≤0.1	≤0.015	≤0.1	0.01	≤0.1	0.01
Gentamicin	12.5	0.12	12.5	0.5	3.1	0.25	50	16	50	4.0
Penicillin	≤0.1	≤0.015	≤0.1	≤0.015	≤0.1	≤0.015	≤0.1	0.5	≤0.1	0.06
Tetracycline	1.6	≤0.015	3.1	0.06	1.6	0.12	3.1	0.12	3.1	0.12

[a] MICs by the broth dilution method were obtained from the CDC.

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