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Unreliability of Direct Antibiotic Susceptibility Testing on Wound Exudates

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Direct susceptibility testing was performed on 110 specimens of wound exudates. Growth was inadequate in 76 of these specimens. Of the remaining 34 specimens, only 5 produced results corresponding to those obtained by testing individual bacterial isolates by the Kirby-Bauer technique. This study confirms that direct susceptibility testing of wound exudates may provide misleading and clinically unreliable information on more than 95% of specimens.

Despite the demonstration (4) that antimicrobial susceptibility tests performed on mixed cultures may provide unreliable results, many physicians and surgeons persist in requesting or coercing laboratories to attempt this determination directly on clinical specimens. A common example is the clinician's insistence that antibiotic susceptibility tests be performed directly on wound exudates in the hope of obtaining information rapidly that would aid in the selection of an appropriate drug.

The present study compares the results obtained with such direct susceptibility tests with the results obtained on individual isolates from the same specimen.

Surgical and wound specimens were routinely obtained on cotton swabs that were placed in vials of Amies transport medium without charcoal. Upon arrival in the laboratory, the swab was placed in 1 ml of tryptic soy broth and agitated briefly with a Vortex mixer. A second sterile swab was used to inoculate this broth onto a 150-mm plate of Mueller-Hinton agar containing 5% sheep blood; the remainder of the broth was used to inoculate a variety of media conventionally used for such specimens. Twelve disks containing ampicillin, carbenicillin, cephalothin, chloramphenicol, clindamycin, erythromycin, gentamicin, kanamycin, oxacillin, penicillin, polymyxin, or tetracycline were dropped onto the surface of the Mueller-Hinton plate with a dispenser and each disk was pressed into place with a sterile forceps. Plates were incubated for 18 to 24 h at 35 C, and zone sizes were recorded. Determinations of "susceptible" or "resistant" were made according to the Kirby-Bauer criteria. Bacteria recovered from the specimen on the conventional media were isolated and identified, and individual susceptibility tests were performed by the Kirby-Bauer technique.

One hundred and ten specimens were tested by this procedure. Seventy-six of these specimens showed little or no growth on the primary susceptibility plate, precluding the initial assessment of susceptibility. However, 24 of these specimens subsequently grew one to six bacterial species; 11 of them contained one to five anaerobic species.

Thirty-four specimens produced sufficient growth on the primary susceptibility plate to permit the measurement of zone diameters. Five of these specimens showed agreement between the two methods with all 12 drugs tested; each of these specimens subsequently yielded a single organism (*Staphylococcus aureus*, 2; *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Salmonella haddon*). The remaining 29 specimens showed marked discrepancies between the two methods for the various drugs tested (Table 1). The average overall agreement between the direct and the Kirby-Bauer methods was only 39%. Four of these specimens were pure cultures (*S. aureus*. *K. pneumoniae*, *P. aeruginosa*, and *Escherichia coli*); the remainder yielded multiple organisms, ranging from two to eight species per specimen. Thirteen of these specimens contained one to five species of anaerobic bacteria.

Direct susceptibility testing resulted in 17% of the drug-organism combinations being erroneously reported as susceptible; false indications of resistance occurred with 44% of the combinations. These results corroborate an earlier study that employed artificial mixtures of bacteria (4). Barry et al. (1) evaluated direct susceptibility tests performed on urine and concluded that, even when a specimen contains

TABLE 1. *Results of direct susceptibility testing compared with results obtained on individual isolates*

Drug	Susceptible by direct test; all organisms susceptible[a]	Resistant by direct test; all organisms resistant[a]	Susceptible by direct test; 1 or more organisms resistant[a]	Resistant by direct test; 1 or more organisms sensitive[a]	Agreement (%)
Ampicillin	3	7	9	10	34
Carbenicillin	6	1	6	15	25
Cephalothin	6	1	8	14	24
Chloramphenicol	10	3	3	13	45
Clindamycin	1	12	2	14	45
Erythromycin	3	12	2	12	52
Gentamicin	10	0	12	7	35
Kanamycin	1	6	5	15	26
Oxacillin	1	19	2	7	69
Penicillin	1	16	2	10	59
Polymyxin	3	6	6	14	31
Tetracycline	3	4	2	20	24

[a] When tested individually.

a single species of a microorganism in fairly large numbers, the test may not provide useful information. Our results confirm these conclusions.

Cultures from infected wounds often contain multiple organisms representing the normal commensal skin flora, as well as the actual etiological agent(s) of the infection. Organisms may be present as simple contaminants or may reflect colonization or infection, a determination that the laboratory is unable to make. The rational goal of treatment should be eradication of the agent responsible for the wound infection, rather than a futile attempt to sterilize the wound. Microorganisms in mixed culture may respond to antimicrobial agents differently from those in pure culture, and it may not be necessary to eradicate every bacterial species to achieve a cure (2). Indeed, elimination of the normal resident flora by antibiotics may produce an ecological vacuum and facilitate the establishment of new resident species (3).

In the present study, direct susceptibility testing provided clinically reliable information on fewer than 5% of the specimens. We believe that this practice should be condemned as a poorly controlled, unstandardized technique that can only be expected to produce gross errors of interpretation. Use of Gram-stained smears that appear to indicate that a single species of pathogen is present in the specimen cannot be relied upon as a criterion for performing a direct susceptibility test, since other organisms may be present in numbers too low for visualization.

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